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The Examination of Medical Coverage, Emergency Policies and Procedures, and the Implementation of Prevention Strategies Before and After Sudden Death in the Secondary School Setting

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The Examination of Medical Coverage, Emergency Policies and Procedures, and the
Implementation of Prevention Strategies Before and After Sudden Death in the Secondary
School Setting

Joseph M. Olivadoti
B.S. Kean University, 2014

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Approval Page

Master of Science Thesis

The Examination of Medical Coverage, Emergency Policies and Procedures, and the
Implementation of Prevention Strategies Before and After Sudden Death in the Secondary
School Setting

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TABLE OF CONTENTS

Chapter I: Review of the Literature.....	7
Introduction.....	7
Leading Causes of Sudden Death in Sports.....	9
Cardiac	10
Catastrophic Brain Injury.....	13
Exertional Heat Stroke.....	16
Exertional Sickling.....	20
Lightning.....	22
Asthma	23
Cervical Spine Injury	24
Speculations of Preventing Sudden Death in Sports	27
Emergency Action Plan	27
Coaches Training	29
Proper Medical Coverage	30
Changes in Athletic Programs	32
Proactive v Reactive	34
Barriers to Making Change	35
Conclusion	36
References	38
Chapter II: Introduction	43
Chapter III: Methods	46
Chapter IV: Results	51
Chapter V: Discussion	62
References	69
Appendices.....	71

ABSTRACT

Sudden Death in the Secondary School Setting
Joseph M. Olivadoti, University of Connecticut

Context: Researchers have identified factors such as lack of emergency action plans, lack of policies and procedures, lack of treating the athlete, predisposing factors, and most importantly inappropriate medical coverage as the critical components of sudden death in the secondary school system however, the evidence to support these identified factors is lacking. **Objective:** To examine the underlying predisposing factors of sudden death cases in the secondary school setting between January of 2000 and June of 2013. **Design:** Mixed Methods Research Design **Setting:** Secondary schools in the United States that experienced a sudden death in sport as indicated by the National Center for Catastrophic Sport Injury Research. **Patients or Other Participants:** Forty-nine out of 279 (17.56%) schools responded to our survey. **Intervention:** Each school was contacted via telephone or email for initial contact and consented to partake in the study. Upon completion and agreement, the schools were then sent an online questionnaire using Qualtrics™ and allowed the option to partake in an in-depth phone interview on a “rolling enrollment basis.” Phone interviews were recorded and transcribed verbatim. **Main Outcome Measures:** Descriptive statistics and content analysis with multi-analyst data triangulation. **Results:** Of the schools that responded to our survey, 71% of data reported that there was not an athletic trainer present during the fatality, 39% of schools did not have or follow an emergency action plan (EAP), and 16% of schools did not have coaches trained and certified in CPR and AED at the time of incident. Emergent themes from the in-depth interviews (n=11) included: the death was a devastating impact, the school employee’s perception vs. reality is contrasting, and in the reactive nature changes occur within the school post death. Modification of policies was the largest change (64%) but addition of medical care was also added in schools (36%).

Conclusion: This is the first study to determine that a larger percentage of deaths (71%) occur at the high school setting when no athletic training services are present at the time of the incident. Although this does not prove that athletic trainers would prevent sudden death in call cases, it certainly supports the best practice recommendation that adequate medical should be present for the prevention of sudden death. If adequate knowledge of the scope and value of athletic training services has been present prior to, it demonstrates a need for increased medical coverage in this setting to provide athletes with the appropriate level of emergency care. The misconception of sudden death and athletic trainers may be the barrier that causes a reactive change from the death instead of a proactive change for the future. **Key Words:** Sudden death, athletic trainers, secondary school, medical coverage, emergency action plans

CHAPTER I

REVIEW OF THE LITERATURE

I. Introduction

Athletic participation among secondary school level children is popular and the numbers are steadily increasing in recent years. Over 7.6 million students were participating in high school sports during the 2011-2012 academic school year, which was an increase of approximately 24,500 participants from the previous year and an increase from an estimate of 7 million participants in 2005.^{1,2} With the increase in number of participants at this level comes an increase in the number and type of injuries incurred by these athletes. Approximately 1.4 million injuries occur annually in high school athletes which translates to an injury rate of 2.4 injuries per 1,000 athlete exposure.^{3,4} Often the injuries are minor and an athlete can return to play within 7 days,³ however there are several injuries that result in sudden death that are not so fortunate.^{5,6,7}

The secondary school level experiences the highest amount of athletic related deaths compared to young adults.^{3,5,7,8} It was found that almost 40% of life threatening injuries sustained by children age 6-18 were sport related. This is a large increase compared to young adults (ages 19-44) whose sport-related life threatening rate is at 12%.⁷ One study examining a 20 year period of sport-related deaths between 1990-2010, determined that the majority of the deaths were football-related fatalities, or an average of 12.2 deaths per year and an injury rate of 1 per 100,000 participants or 45% of all fatalities.⁸ Various other sports comprised the remaining 55% of sport-related deaths. Basketball, soccer, track and field, and cross-country, were among the highest with 23%, 5%, 8% and 3% respectively. In an annual report conducted by the National Center for Catastrophic Sport Injury Research (NCCSIR), it was determined that between the fall of 1982 and spring of 2013 there were 2,101 catastrophic events at the high school and collegiate level, 80.0% of which were at the high school level. Seasonal data revealed

that in the fall sports (football, cross country, soccer, field hockey, and water polo) accounted for a majority of the catastrophic events equaling 65.9%, followed by winter sports (basketball, ice hockey, swimming, gymnastics, skiing and wrestling) at 20.5% and spring sports (baseball, softball, track and field, lacrosse, golf, and tennis) at 13.7%.⁵

Of the reported deaths in high school and college, the majority comes from similar causes including cardiac, head injury, heat illness, and sickle cell related death. The 2 highest causes of death in children playing football are cardiac emergencies and head injuries which account for 41.2% and 25.5% respectively.⁸ Another report, which included all sports, equaled out to cardiac being the result of 56% of the deaths of this age group.⁶ As you can see in Figure 1, football fatalities between July 1990 and June 2010 mirror the four previously mentioned causes; cardiac, head injury, heat illness, and sickle cell. Together these four causes comprise 87% of the total causes in both college and high school football. Figure 2 follows up with the year-by-year run down of the deaths coming from the top 3 causes.⁸

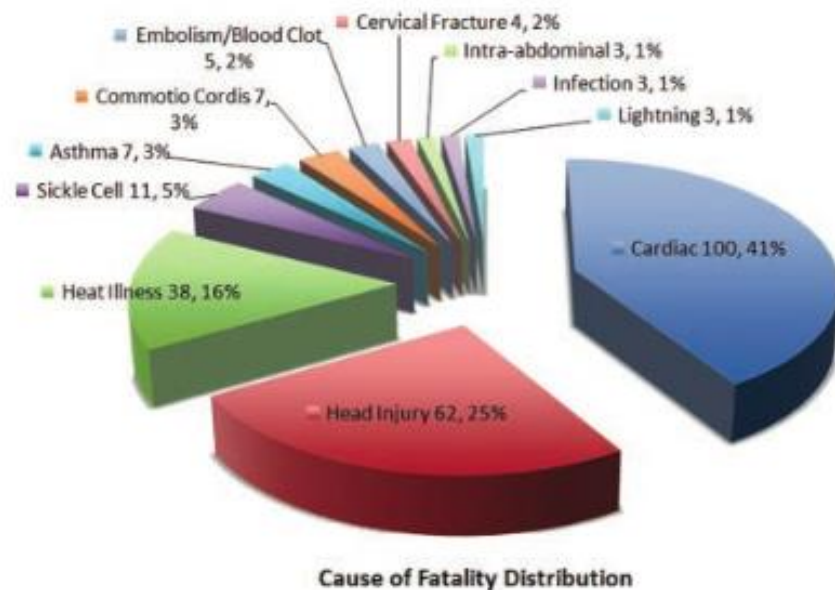


Figure 1. Number and percentages of football fatalities by diagnosis.⁸

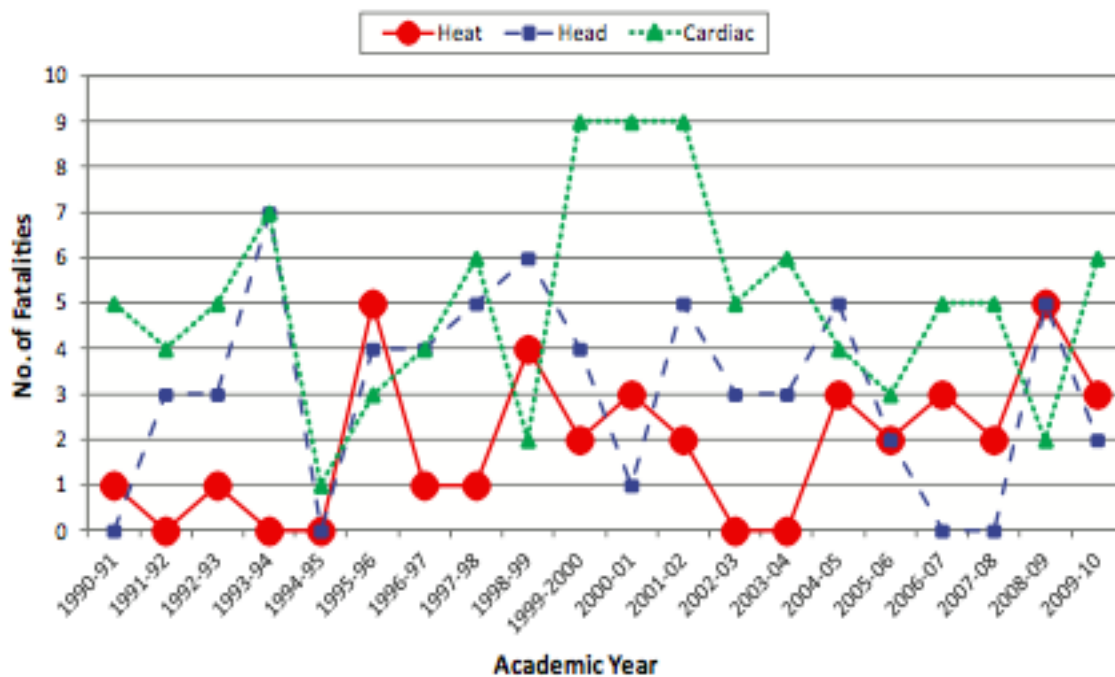


Figure 2. Incidence trends of heat, head and cardiac fatalities in football.⁸

II. Leading Causes of Sudden Death in Sport

There is a wide range of documented causes that have led to sudden death during sports. In no specific order, asthma, cervical spine injuries, diabetes, exertional heat stroke, exertional hyponatremia, catastrophic brain injuries, head down contact in football, lightning, exertional sickling, and sudden cardiac arrest are the top 10 causes at this point.⁹ Each has its own predisposing factors, sign, symptoms, and conditions known to increase likelihood. Individual knowledge related to the characteristics of each has been suggested as a helpful way of preventing the occurrence.⁹ Another area that has been suggested to help prevent and or minimize the risk of sudden death has been appropriate medical personnel.^{9,10} It has been suggested that with appropriate medical personnel that correct guidelines and treatment will be more likely implemented, therefore mitigating the risk of death. The inherent issue with such recommendations is that little to no research has examined these suggestions. Before we can

increase knowledge related to a specific condition, we must dive deeper into our understanding each cause of sudden death.

Cardiac

With the overall population of athletes being at a generally low risk for sudden death, a large number of cardiovascular diseases have been linked to sudden death in youth athletes upon exertion.¹¹ Sudden cardiac arrest (SCA) is considered to be the leading cause of death in exercising young athletes.^{6,9,12,13} The incidence rate is estimated to be between 1 in every 100,000 and 200,000 in high school athletes, however due to the national reporting system, the true evidence of SCA is unknown and probably left underestimated.⁹ In some studies, 110 SCA's were recorded in one year during sports alone. This equates to one SCA every 3 days in the United States.^{9,14} The reason that these athletes are predisposed to SCA while playing these sports is not actually the sport specifically. Usually, the physical exercise will act as a trigger in the presence of any underlying cardiovascular condition, therefore predisposing them to a life-threatening scenario.¹⁵ Figure 3 shows a good comparison between the incidences in athletes vs. non-athletes.

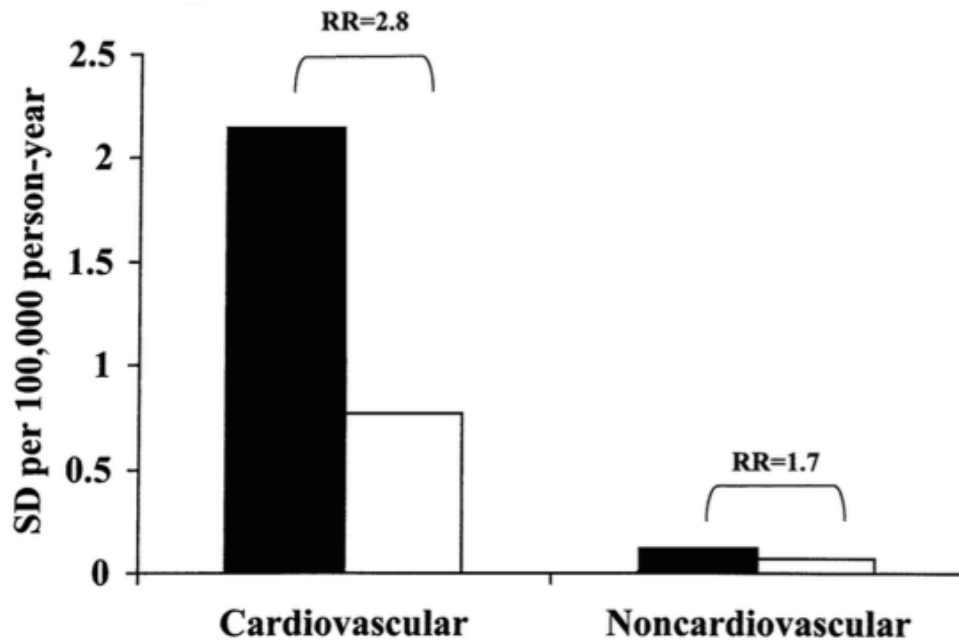


Figure 3. Incidence and relative risk (RR) of sudden death (SD) among athletes (solid columns) and non-athletes (open columns) from cardiovascular and non-cardiovascular causes. Athletes had a 2.8 RR of cardiovascular SD, as compared with a 1.7 RR of non-cardiovascular SD.¹⁵

When examining SCA, there are 7 fairly common sub-classifications of underlying causes. The leading type is labeled as hypertrophic cardiomyopathy (HCM), which has been responsible for ~25% of all cardiac deaths in exercising youth athletes.^{9,13} HCM is an asymmetrical hypertrophied and non-dilated left ventricle found in an estimated 1 in 500 people.¹¹ A second type are coronary artery anomalies which have been found to be responsible for 14% of SCA in exercising youth athletes.^{9,13} HCM and coronary artery anomalies represent 39% of all deaths in exercising youth athletes. The remaining 71% includes other conditions such as commotio cordis, myocarditis, arrhythmogenic right ventricular dysplasia, Marfan syndrome, valvular heart disease, and many others.⁹

Prevention of SCA is the biggest part of the battle; the preparticipation evaluation (PPE) is the current standard of care for primary prevention of SCA.¹² This evaluation, which is

commonly considered the sports physical for an athlete, should consist of a comprehensive personal and family medical history. For best results it is important to be completed by both the athlete and family members with knowledge of the families health history.¹² After completion, the PPE should be reviewed by your medical staff and make note of any information that could lead to an issue at a later point. Screening by history and physical examination alone may have limited sensitivity to identify athletes with any at risk conditions, however the detection of asymptomatic conditions could be identified with the presence of exertional syncope, chest pain, family history of sudden death or exercise intolerance listed on the PPE.⁹ An in-depth pre-participation screening using test such as a 12 lead ECG, is one available strategy to help prevent occurrence of SCA, however, accuracy may be questioned.⁹ Since 80% of patients who have a SCA are asymptomatic until sudden cardiac arrest occurs, the common screening has not been showing valid results.^{9,13} The American Heart Association has recently cited the poor sensitivity, a high false-positive rate, poor cost-effectiveness, a lack of physician infrastructure to conduct screens and concerns regarding the overall cost of implementing such a program in the United States.¹⁶ A 7% false-positive rate and a 2% overall disqualification rate from athletic participation,¹⁷ brings up a large issue of excluding many athletes who are otherwise safely able to participate.¹² Cost effectiveness of implementing schools to perform an ECG on all athletes is very irrational seeing that many cannot seem to afford basic medical care. One basic ECG test costs \$50 (based on Center for Medicare Services-approved reimbursements), and that does not include any additional test that may be needed for certain individuals.¹⁶ Currently, the European Society of Cardiology, the International Olympic Committee, and multiple professional sports leagues support the routine use of a 12 lead ECG as part of the pre-participation evaluations. These leagues have implemented the use of them following a study that had shown a 77% greater

power to detect HCM than history and physical examination alone, leaving a 89% reduction in SCA when combined with history and physical examination.^{12,17,18}

Since the PPE's have not been shown to completely help prevent SCA, it goes onto the recognition of the symptoms as it happens. Any athlete that collapses during activity and is termed as unresponsive, should automatically be suspected of SCA.⁹ Upon collapse the individual's vital signs should be assessed and the emergency action plans (EAP) should be activated. At this point, an athletic trainer or one properly trained and certified in CPR should begin doing such until an AED is available for use. The greatest factor affecting survival is the time from rest to defibrillation.⁹ Survival rates have been noted as 41%-74% if CPR and defibrillation occurs within 3-5 minutes of collapse.^{9,19}

Catastrophic Brain Injury

Mild traumatic brain injury, or also known as a concussion, is common in both contact and non-contact sports at any level, especially high school. The Centers for Disease Control and Prevention estimates that 1.6 to 3.8 million sport related concussive injuries occur annually in the United States.^{9,20} High school athletes making up most concussions yearly, due to a much higher incidence rate of fatal and nonfatal brain injuries compared to collegiate athletes.⁸ Severe catastrophic traumatic brain injuries are rare for all populations, however injuries such as subdural and epidural hematomas and malignant cerebral edema (Second-Impact Syndrome) do occur, and occur with direct trauma, making them more prevalent in athletics.⁹ The direct trauma causes a reactant in the brain that causes it to swell and/or blood pooling to occur, in retrospect, increasing intracranial pressure, causing brainstem herniation and respiratory arrest to follow if not treated timely.⁹ It is estimated that 235,000 Americans are hospitalized for a non-fatal Traumatic Brain Injury (TBI), 1.1 million are treated in the emergency department and 50,000

die annually.²⁰ Making catastrophic brain injuries rank second, behind cardiac injuries, as the most common cause of fatalities in football players.²¹ Its high ranking in football brings up big concern with those athletes, but fatal brain injuries have occurred in almost every sport, including wrestling, baseball, lacrosse, track and soccer.⁹

The prevention of a brain injury comes from a wide approach from your medical staff, especially your athletic trainer. Prior to activity occurring, athlete, coaches, and parents should be educated about all types of TBI. They should all be provided an education session before the season starts to teach the recognition of concussion, including such as the common mechanisms, signs, and symptoms.^{9,10} As well as the commonalities, they should also be instructed on the importance of an athlete not participating while symptomatic to mitigate the risk of subsequent injuries.^{9,10} In equipment intensive sports with helmets (football, lacrosse, hockey, etc.), the education to all on how helmets do not prevent concussions is needed at all levels.^{9,10} The PPE should also be used as a prevention tool, the athletic trainer or medical supervisor who reviews the PPE should pay attention to those who list previous concussion injuries and understand that they now have an increased chance of another concussion. A cohort study by Guskiewicz et al.²² reported that collegiate football players who have had 1, 2, and >3 concussions have a 1.4, 2.8, and 3.4 times higher rate of sustaining a concussion, respectively. Overall suggesting that concussion may present a cumulative effect over the time of a career.

Concussions are going to occur at a high rate in athletics, and therefore the recognition is imperative to limit any life threatening injuries. However, since approximately 90-95% of concussions involve no loss of consciousness and estimated that 49-75% of athletes do not report their concussions, recognition more difficult than other traumatic injuries.^{9,23} The lack of reporting and recognition only strengthens the need for an athletic trainer or medical professional

that is aware of the signs and symptoms to approach an athlete with a common concussion mechanism. Also, in conjunct with the PPE, the implementation of comprehensive, objective testing should be used both as a baseline and post injury assessment. The testing should include symptom, cognitive, and balance measure to represent concussion measures and not one should be used in isolation for any diagnosis or return to play decisions.⁹ Some tests are the Balance error Scoring System (BESS), Standardized Assessment of Concussion (SAC), SCAT 3, and Graded Symptom Checklist. The administration of these listed test should be performed by an athletic trainer or medical professional specifically trained in the management of head injuries while assessing an athlete of a suspected concussion as noted by the Inter Association Task Force.¹⁰

The importance of correct treatment and return to play after a brain injury is important for preventing subsequent injuries. Athletes that sustain such injury cannot participate in sports and should be evaluated on a regular basis by using the objective measures such as the graded symptoms checklist.^{9,24} It is crucial to ensure a full recovery by these athletes to prevent catastrophic injuries such as second impact syndrome. Second impact syndrome comes from a patient who develops cerebral edema (concussion), and then receives a second impact. The brain will then lose the ability to auto regulate intracranial and cerebral perfusion pressure, leading to deaths that have been reported in 2-5 minutes of impact.²⁵ Second Impact Syndrome is reaching a 50% mortality rate and a 100% morbidity rate in those who sustain the injury.⁹ More research is needed in this area to determine many questions around second impact syndrome. A study found that 25% of athletes with a brain fatality had a history of concussions, with 16% within 1 month of the persons death.⁸ Representing that one could have a higher likeliness of these deaths when they are returned from their previous injury too soon. To prevent such, athletes are to

follow an adopted gradual return to play protocol that deals with an athlete exerting himself on a progressive level daily as long as the symptoms are not reproduced (Table 1).^{9,24} The mitigation of risk for deaths due to a brain injury can all be gained by proper prevention, recognition, and treatment in both minor and sever TBI.

Exertion Step	Activity
1	20-min stationary bike at 10-14 mph (16-23 kph)
2	Interval bike: 30sec sprint at 18-20 mph (29-32 kph) 30sec recovery x10 repetitions; body weight circuit: squats, push-ups, sit-ups x20sec x3 repetitions
3	60-yd (55-m) shuttle run x10 repetition with 40 sec rest; plyometric workout: 10-yd (9-m) bounding, 10 medicine ball throws, 10 vertical jumps x3 repetitions; non-contact sport specific drills x15min
4	Limited, controlled return to practice with monitoring for symptoms
5	Full sport participation in practice

Table 1. Graduated Return-to-Play Sample Protocol⁹

Exertional Heat Stroke

Exertional heat stroke (EHS) is when a person is in a state of extreme hyperthermia due to the excess production of metabolic heat. It is normally caused by muscular exercise that exceeds the body's heat dissipation rate.²⁶ There are two basic rule-in criteria for EHS. 1.) a core body temperature greater than 104/105°F and 2.) central nervous system dysfunction (CNS).⁹ Among athletes, EHS is one of the top 3 causes of deaths yearly, but may rise to number 1 during the summer months due to the high risk environment.⁹ EHS is a fatal condition, that resulted in 32 deaths over a 10 year span from 2003-2013,²⁷ but it is completely preventable with proper precautions and appropriate treatment all of which can be performed by an athletic trainer.⁵

The risk of heat fatalities is 3.8 times greater in college participants compared to high school participants,⁸ but the same risk factors are associated at both levels. Obese patients (BMI >30 in adults) have an increased heat production and a low surface area for heat dissipation, which leads to greater chances of EHS in these individuals.⁸ Physical fitness, which has been shown to be the biggest individual factor,²⁶ is associated because a person's ability to tolerate exercise in the heat is dependent on their fitness level. In a study by Rav-Acha et al.²⁶ it was seen that 5/6 fatal EHS cases dealt with an athlete that presented low physical fitness levels, and 6/6 demonstrated physical effort unmatched to physical fitness. Athletes who are less fit than their teammates need to work harder and at a higher intensity to attempt to perform at the same level. Therefore, poor physical fitness and higher relative intensity results in a higher metabolic heat production in these individuals.²⁸ In addition to the athlete's physical fitness, an appropriate heat acclimatization guideline is needed in every school. The physiologic response that occurs with acclimatization enables the body to deal with the thermal stressors that are occurring and allows the body to make many adaptations for the heat.^{9,28} The acclimatization guidelines decrease the risk of developing a heat-related illness, especially during the preseason practice periods when your body has not been exposed to the heat during exercise. It has been shown that approximately 66% of heat-related deaths have been in the month of August, and 71% of them occurring in the first 2 weeks.²⁹ August is known as a very warm month in the northern hemisphere and is when many fall sports will start their preseasons, it is possible that the lack of acclimatization may have been associated in these cases with the bulk of deaths occurring in the first 2 weeks.²⁹ Added clothing or equipment is another factor that plays a part in EHS. This not only adds more weight for the person to carry, but it provides a barrier for evaporation and cooling. In football, the shoulder pads and helmet cover approximately 50% of the skin surface

area and then with the 20% that is covered by other clothing, 70% of a players body now has a barrier for their heat reactions.³⁰ Clothing and equipment have been proven to increase the physiological strain on a normal day, it is then heightened further in the heat.³⁰

The environment may be the biggest extrinsic factor in heat related issues. Wet-bulb globe temperature (WBGT) and the environment conditions can affect an athlete's ability to tolerate exercise in the heat depending on their levels.²⁷ During exercise, the higher the air temperature, the higher the thermal strain, which can be mediated largely by high levels of aerobic fitness and acclimatization however, if the relative humidity increases along with the heat, the body loses its ability to use evaporation as a cooling method resulting in an uncompensable heat stress that the athlete is unable to overcome.⁹ WBGT takes into account temperature, humidity, wind speed, and solar radiation and is commonly used to determine the risk level of the respective practice or activity.³¹ WBGT is used to establish guidelines that can limit the practice time, work/rest ratio and water consumption. Figure 4 gives an example of a guideline used by Georgia High Schools. WBGT guidelines must be based on the specific region and may vary in different locations due to the different environment conditions that are experienced in different parts of the country.³¹

WBGT READING	ACTIVITY GUIDELINES & REST BREAK GUIDELINES
Under 82.0	Normal activities--Provide at least three separate rest breaks each hour of minimum duration of 3 minutes each during workout
82.0 - 86.9	Use discretion for intense or prolonged exercise; watch at-risk players carefully; Provide at least three separate rest breaks each hour of a minimum of four minutes duration each
87.0 - 89.9	Maximum practice time is two hours. For Football: players restricted to helmet, shoulder pads, and shorts during practice. All protective equipment must be removed for conditioning activities. For all sports: Provide at least four separate rest breaks each hour of a minimum of four minutes each
90.0 - 92.0	Maximum length of practice is one hour, no protective equipment may be worn during practice and there may be no conditioning activities. There must be 20-minutes of rest breaks provided during the hour of practice
Over 92.1	No outdoor workouts; Cancel exercise; delay practices until a cooler WBGT reading occurs

Table 2. Georgia High School Athletic Association guidelines based on WBGT reading while exercising in the heat.³¹

Proper diagnosis of EHS hinges upon an accurate core body temperature measurement. The most field-expedient method currently available is via rectal thermometry. A rectal thermometer is imperative for observing the possibly 104/105°F temperature because all other temperature measurement devices have been found to give inaccurate readings during individuals who are exercising.³²⁻³⁴ When EHS is occurring, the key factor is the time from onset to the start of cooling. The length of time that an athlete's core temperature remains above the EHS temperatures, correlates directly towards the severity of the injury or fatality, therefore it is imperative that the body be cooled to safe levels in a fast and effective manner.³⁴ Cold water immersion (CWI) has been noted as the gold standard cooling technique due to its high rate of cooling. Proulx et al.³⁵ tested the cooling rate of CWI at various temperatures (between 2°C-20°C) and they all showed a cooling rate that was greater than .2°C per minute, which has been determined to be higher than any other cooling method. The EAP should be activated in a situation regarding EHS, however “Cool first, transport second” should be followed as long as

appropriate medical professionals, like an athletic trainer, are on site while treating the EHS to continue monitoring the athlete.⁹

Exertional Sickling

Sickle cell trait (SCT) is a condition that is resulted from inheritance of one gene for sickle hemoglobin (red blood cells) and another for normal.^{36,37} During intense exercise, the sickle hemoglobin can change shape into a “bean” or “quarter-moon” shape, leading to a clog of the blood in the blood vessels. While clogged, the athlete is then trying to use muscles that are not receiving oxygen, leading to collapse.³⁸

Exertional sickling has become a major barrier in sports in the recent coming. Between the years of 2000 – 2010 there have been 10 deaths related to exertional sickling in NCAA Division I football, that is 63% of the total amount of deaths in division I football over that time.³⁶ Dale Lloyd II, a Rice University football player who had died in contribution to SCT had sparked many remarks in the NCAA.³⁹ In result of the legal case between the family v Rice University, NCAA, coaches and others, the NCAA implemented one of the largest mandated genetic screening programs in the United States looking for those athletes with SCT. High school however, it has not been shown to be as big of an issue. Of the 10 deaths that have occurred by sickling, all of them have occurred during a high intensity condition session, none during practice or game.³⁶ The strength and conditioning coaches who run the sessions should be certified to administer CPR/AED use if needed,⁴⁰ however some strength coaches will be focusing on running the athlete into the ground more than paying attention to any tell signs; leading to the importance of an athletic trainer as medical coverage at condition sessions just as much as a practice or game. Even with sickling being a medical emergency and leading to many

deaths over the years, one with SCT should not be disqualified from sport, nor discontinue any exercise.^{9,10,38}

The PPE should be used as a prevention tool regarding this condition. Identifying those who do have the presence of SCT is important for the medical staff to know. Many athletes will not know about their SCT status, but however, all 50 states do screen at birth leading to access of the information.¹⁰ It has been reported SCT is found in about 8% of African Americans, .5% of Hispanic and .2% of white individuals.³⁶ Like many other sudden deaths, education plays a part in the preventing any occurrence. It is important to inform the athletes with SCT of the risks that are involved and stress the importance of setting their own pace, progression in training, excusing the athlete from some tests or reps, hydration, and to discontinue once any of the symptoms do occur.^{9,10,36,38} As well as informing the individual athlete, the importance of informing fellow teammates, coaches, and parents is imperative to look out for any of the signs and symptoms that may occur, and to not be afraid to report any activity.

Once the sickling athlete starts feeling any of the associated signs and symptoms for exertional sickling, they should be immediacy removed from that current practice or conditioning session. The symptoms will present with leg or low back cramping, weak muscles, reporting they cannot catch their breath, and fatigue.^{9,36} In turn, this will relate back to the recognition and ensuring you know your athletes with SCT because if an athlete had come up to you with these presenting symptoms, another condition such as a heat illness may be suspected and treated incorrectly.

Once the athlete is removed from participation from suspicion of exertional sickling, it should be treated as a medical emergency and immediate action can save lives.⁹ The athletic trainer or appropriate medical professional should begin to assess vital signs and administer a

high flow of oxygen (15 L/min), while also activating the schools EAP and preparing for cooling and/or CPR.^{9,10,36} Exertional sickling has been the primary cause for many deaths over the past 10 years, proper recognition and appropriate treatment administered by an athlete trainer can help start to mitigate the issue.

Lightning

Different than some of the other causes of sudden deaths that have been mentioned, lightning is a death that is not caused by activity specifically, however holds a large risk factor in certain conditions. During the past decade, lightning was responsible for an average of 42 deaths in the United States.⁴¹ Similar to other issues, lightning deaths can be prevented by proper strategies and plans prior to the event, if not implemented quickly fatalities can occur.⁹

Avoiding the risk of a lightning fatality is translated to the exposure you have during a thunderstorm, the longer yourself is exposed to a thunderstorm the higher the risk. In a school setting, if a thunderstorm is occurring, changing the practice to indoor or cancelling that day will negate your risk for injury however, if a practice or event is going on and lightning is seen or thunder is heard, people should vacate to a location that is identified as a safe location as per EAP until it is clear for competition.⁹ It is important for the location on the EAP to be completely indoors, a 4 walled structure because no place outdoors is completely safe from lightning including dugouts, rain shelters, or storage sheds.^{9,41,42} The athletic trainer on site should be used for observation of the weather around them with combination of federal weather monitoring websites to ensure a safe environment and call off any play that is in danger. Since athletes, coaches, and possibly spectators need time to move to the identified safe place, it is important to call of play as it reaches 15 miles away or when the lightning is seen.^{9,41} Once the last roar of thunder has been heard and the last strike of lightning has passed, 30 minutes must pass before

play can resume. It has been seen that the end of the storm can be just as dangerous as the beginning, so waiting 30 minutes post, yields a 90%-95% confidence that no more lightning will occur.⁴¹

In a situation where one is struck by lightning immediate care is required. One should not be afraid to touch or treat a patient because they will not hold an electrical charge, however it is recommended to carry them into a safe area to remove the rescuer from a vulnerable situation.^{9,43} The regain of normal cardiorespiratory status is key, therefore CPR should be performed and an AED should be placed on the athlete. The AED may not indicate defibrillation, however CPR should still be continued to give the best chances of survival.^{9,41,43}

Asthma

Asthma is a disease which the airways become inflamed and airflow is restricted, triggered by many allergens, pollutants, aspirin, non-steroidal drugs, chlorine in a pool, cold, or exercise.^{9,44,45} In 2009, it was estimated to affect 22 million people in the United States, 6 million of them being children.^{9,44} Asthma has been proven to have no cure, and at any time it can flare up from one of its triggers, but many can live a normal healthy lifestyle with little to no symptoms.

Preventing an asthma attack in an athlete can be a difficult task due to the many different types of triggers, some which aren't exercise. The athletic trainer and rest of the sports medicine staff should identify any athlete who has listed asthma on their PPE for notice of the ones whom are bearing the most risk. The athletic trainer should also educate the athletes with asthma on the importance of a structured warm-up protocol, the use of medication, and signs/symptoms that should be made aware of. Proper medication use along with a lengthy warm-up period prior to

exercise will lead to minimal symptoms experienced by the patient. The warm-up may preclude a need for repeated medications as well.⁴⁴

Timely recognition of an asthma attack, as well as proper use of medication can provide optimal benefit for any student athlete. The signs and symptoms that will be recognized will include confusion, drowsiness, use of accessory muscles for breathing, wheezing, cyanosis, coughing hypertension, bradycardia or tachycardia, also including others.^{9,45} Once the symptoms are noticed, a quick relief medicine such as short-acting inhaled B₂-agonist that quickly causes bronchodilation by relaxing airway smooth muscles.^{44,45} Prior to, long-term medication such as long-acting inhaled B₂-agonist will help to reduce airway inflammation and prevent asthma symptoms. Studies have shown that the long-acting agents work best as a combination therapy with another inhaled corticosteroid and has been shown to decrease the need for short acting agents.⁴⁶ During exercise, it is imperative that the medication is in a close location in case of emergencies. An athletic trainer should have full access if not possession of medical emergencies when they are in charge. The medication should be taken immediately once the symptoms are noticed due to the onset of action for a short-term agent being approximately 5-15 minutes and can be taken 1-3 times per hour.^{9,44} If symptoms do not resolve from the inhaler after 1 hour, the athletic trainer should activate the EAP for an asthma attack and start providing the athlete with supplemental oxygen to help maintain the blood oxygen levels above 92% saturation.^{9,47}

Cervical Spine Injury

There have been an estimate of 11,000 new cases of spinal cord injury every year, approximately 7.4% of them occurring from sports. Sport participation being the second most common cause for spinal cord injury for patients 30 years of age or younger.⁴⁸ Football is the sport that has been seen to result in the highest amount of cervical spine injuries and fatalities at

all levels, however the instances have had a dramatic decreased over the decades (Table 1) with a variety of rule changes and regulations, such as the no spear tackling rule implemented in 1976.^{8,49} Although the risk of a cervical spine injury in other sports involving less contact is lower, other sports still pose an at large risk for these types of injuries.

Year	Head		Cervical Spine	
	Frequency	Percent	Frequency	Percent
1945-1954	87	16.2%	32	26.0%
1955-1964	115	21.4%	23	18.7%
1965-1974	162	30.2%	42	34.1%
1975-1984	69	12.8%	14	11.4%
1985-1994	34	6.3%	5	4.1%
1995-2004	45	8.4%	2	1.6%
2005-2013*	25	4.7%	5	4.1%
TOTALS	537	100.0%	123	100.0%

*Note: nine year period

Table 3. Head and Cervical Spine Injuries By Decade, 1945-2013⁴⁹

The main mechanism of spinal cord injuries is an axial load, and more dangerous when the neck is flexed due to the spine alignment which does not allow the neck muscles to assist in absorbing the force.⁵⁰ This force is the primary cause of cervical fractures, dislocation, quadriplegia and fatalities, leading to a high morbidity and a potential for permanent loss of neural function.⁵⁰ The common mechanism also explains why sports such as football and hockey top instance list in sports. The prevention of cervical spine injuries starts with proper education of the coaches and athletes on the common causes in the individual sport. The athletic trainer will need to educate and ensure that all coaches, especially football coaches are teaching the

correct and safe form of hitting and tackling.^{9,51} The USA Football Heads Up program is a prime example of a program that is promoting safe tackling strategies in youth and high school football.⁵¹ Safety rules should be established for coaches and athletes, while the athletic trainers, equipment managers, and coaches should ensure that the equipment is fit properly and being used correctly.^{9,10,51}

The recognition and initial stages of the assessment is important when diagnosis a spinal cord injury. During the initial assessment, any signs of unconsciousness or altered level of consciousness, bilateral neurologic findings or complaints, significant midline spine pain with or without palpation, or obvious spinal column deformity should be treated by the spine injury protocol that is documented on the EAP.^{9,48,50} Your findings from the initial assessment will tell you what is up next for management. The level of consciousness will dictate your on-field management, if conscious, neurological function via Glasgow Coma Scale, pupillary response, eye movements and visual fields, and function of the extremities should be assessed.⁵²

Once the spinal injury is suspected, rescuers should ensure that the spine is in a neutral position and apply total stabilization to limit any movement and chance of a secondary injury during transportation.^{48,50} Due to this, a healthcare professional with the most training, such as an athletic trainer, should be in charge of the assessment, care, and management of these athletes. Spine boarding with a rigid board for full body immobilization and a hard cervical collar for cervical immobilization should be used for the athlete. In equipment intensive sports with a helmet and shoulder pads such as football, hockey, and lacrosse it had previously been recommended that protective equipment be left on and spine boarded in them. However, under new recommendations by the National Athletic Training Association (NATA)⁵³ it is essential to remove the equipment prior to transport when appropriate. The new rationale is due to the

advances in equipment technology, the athletic trainer considered having the highest level of training in removing equipment, expedited access to the athlete for enhanced care, and chest access is prioritized.⁵³

III. Speculations of Preventing Sudden Death in Sports

There are many speculations that have been mentioned to prevent sudden death in sports at all levels and although research is very technologically advanced in today's society, sudden death is a difficult topic to study since we are unable to have a group of humans volunteers to be in the group that "might die" and is entirely unethical. Therefore, well-published methods that are ensured to 100% prevent a fatality depend on data from real-life field situations and information. Common methods such as development and implementation of appropriate policies and procedures, medical coverage, emergency action plans, and coaching education are speculated as practices that have been suggested to prevent sudden death in sport, however there is no study that can be conducted to answer these questions. The best we can do is make recommendations based on the knowledge that we have, make recommendations, and observe the outcome. This can become a trial and error situation if we look at things prospectively, but if we look at the deaths in a retrospective manner, we might be able to gather some very important information that can help us as we move forward.

Emergency Action Plan

An Emergency Action Plan (EAP) is a written and structured plan on what to do in an emergency situation. The EAP should be composed of but not limited to step-by-step instructions on what to do, emergency personnel responsibilities, location of emergency equipment, and venue directions with map.^{54,55} An EAP should be easy to understand and should also establish accountability for the management of an emergency situation. A yearly review with certified

athletic trainers, team physicians, coaches, administrations and emergency medical services (EMS) should be performed to go over the EAP, since in most cases it is not used too often.^{2,40,54,55} The need for an EAP has been documented by literature and supported by law. In *Kleinknecht v Gettysburg College in 1993*^{2,56} it was decided that an institution owed a duty to each athlete to provide an emergency plan that was adequate for the risks involved in sport participation.

In an emergency situation every second counts, with a well-constructed EAP a smooth transition can be made through the emergency care process. In a case documented by Courson,⁵⁴ a basketball player had collapsed on the court during practice with no previous symptoms of palpitations, dizziness, or syncope. Within 2 minutes of the collapse, an AED had been obtained, applied, and analysis was initiated on the athlete. The AED had found that shock was indicated and one shock was delivered, and then followed by 2 rescue breaths by the athletic trainer. The athlete began to breathe on his own and was transported to the hospital via EMS for evaluation. With the EAP available and practiced by these individuals, a rapid emergency response was facilitated.

One issue with an EAP is that completion without the formation of an emergency team, normally lead by a physician and an athletic trainer, can lead to gaps in the plan. So with many high schools in the United States not employing an athletic trainer, an EAP does not usually end up being completed or done incorrectly. At the point when a school does not employ an athletic trainer; the athletic directors, strength and conditioning coaches, and coaching staffs are accountable for the schools EAP.⁵⁷ The National Collegiate Athletic Association (NCAA) recommends that all institution-sponsored collegiate activity sessions in season or out of season have an EAP that will clearly layout direction in case of an emergency.¹³ A thorough

development and implementation of an EAP is meant to help ensure that the athlete will have the best care provided when an emergency situation does arise.

Coaches Training

A great deal of research related to sudden death has come out within the recent years, and some information providing great information regarding preventing sudden death in sports at the college and secondary school activity levels.^{9,10,40} However some causes of sudden death have been more common in recent years,^{27,36} with many of the cases able to be avoided by enhanced prevention, recognition, and treatment plans.⁵⁷ Unfortunately, in most cases deaths at the high school level occur in the presence of football coaches, and at the college levels during strength and conditioning sessions.⁵⁷

As mentioned previously, lack of awareness and recognition of these common types of illnesses that occur is a huge issue for high school athletics specifically. The medical knowledge that a high school coach has is not nearly on the same level as an athletic trainer, however the basic training and knowledge can help.⁵⁸ Coaches who are trained and certified in AED and CPR have had some training related to cardiac care but may not be completely aware of the specific conditions that can cause sudden death, nor are they capable of recognizing these conditions when they occur in their athletes. Coaches can also help maintain the athlete by initiating lifesaving first aid until a more qualified professional is available.⁵⁷ Last, they lack knowledge about conditions that would need to result in a change or modification of a practice schedule.⁵⁷ It is critical that coaches adhere to their scope of practice and training, and avoid making decisions as to whether or not an athlete can continue or return to play.

Strength and conditioning professionals and coaches both seem to have a different mindset than a medical professional. An athlete who is struggling to complete a run in the heat

may seem weak or out of shape to coaches and is sometimes pushed over the limits. An athletic trainer or another medical professional will be able to provide the proper recognition of a weak athlete or one who may be experiencing a heat illness so proper precautions can be taken. Furthermore, the athletic training is looking out for the health and well-being of the athletes and that is often foremost in their minds. In addition, a certified athletic trainer is required to complete a minimum of 4 years of schooling and pass a board of certification exam. When we compare to the educational requirements to become a coach it is safe to assume that the athletic trainer has more knowledge related to the health and safety of the athlete compared to a coach who may or may not have completed a 3 hour training session.⁵⁹ Barron et al.⁶⁰ demonstrated that only 5.17% of youth coaches earned a passing score on the first aid assessment test and Valdes et al.⁶¹ determined that 47% of strength and conditioning coaches that were surveyed scored a score of $\leq 59\%$ in a questionnaire that asked about preventing and recognizing EHS. An athlete can go from normal functioning to near death within a matter of seconds, and in some situations a decision on treatment is made without communication with the athlete. McGrath et al.⁶² found that 68% of the surveyed football coaches feel that they are confident and qualified to handle an emergency situation. At the same time, they were not as knowledgeable regarding the signs and symptoms of an emergent condition, seeing that perception does not meet reality. A big question is, will more evidence support that a coach can be confident enough to make the correct decision in a true life or death situation?

Proper Medical Coverage

In a life or death injury situation, or even for a normal injury, the highest qualified medical professional can ensure the best care for an athlete. In the secondary school setting, the healthcare professionals that are best positioned to provide effective and efficient medical care to

secondary school student athletes are athletic trainers.⁴ The American Medical Association and The NATA recommend the employment of athletic trainers in all high schools who have an athletic program. Athletic trainers are licensed medical professional specifically taught to prevent, recognize and treat emergencies related to sport. Their educational background, national certification by the Board of Certification, state licensure, years of supervised clinical practice, and yearly retraining provide an athletic trainer with the skills to maintain responsibility of medical care of a large number of athletes.¹⁰ Athletic trainers in combination with EMS, physician and other members of the sports medicine team should serve to respond to athletic related medical emergencies. It has been reported that approximately 50% of secondary schools do not have medical staff present on site to implement the policies related to a certain condition.²⁴ In situations where medical coverage is not available onsite, coaches, athletic directors, or strength and conditioning coaches are left to make difficult decisions that they are not trained to make placing themselves in a very difficult position and their athlete's lives in danger. When it comes to recognizing life-threatening conditions, there is a great overlap of signs and symptoms. Often there are only subtle differences in their presentation and they can easily be confused by someone who is not medically trained.⁵⁹ Unfortunately, these situations occur too often and the lack of appropriate medical coverage leads to a large amount of pressure, responsibility, and liability on the coaches and the school.²⁴

Current best-practice recommendations are that an athletic trainer should be present and accessible for practices and games at their facilities for all secondary school athletic programs. Full-time services are more efficient compared to part-time and per diem due to the increase in likelihood that a plan will be developed throughout the school, hopefully leading to an increase chance of survival. Recent data by Pryor et al.⁶³ reported that 70% of the responded public

secondary schools in the United States have an athletic trainer and 86% of the athletes had access to athletic training services. These numbers are a large increase from what was previously reported in 1999, which stated only 35% of secondary schools in the US were using athletic training services. When examining the private school setting, 57% have AT services, while 84% of all athletes have access to AT services.⁶⁴ Although these data show improvement, nearly 30% or approximately 4,400 high schools across the country will go without medical care during games or practices a majority of the time. Furthermore, medical responsibilities will be burdened on the coach or other members of the high school staff that may or may not have received any training or educational information at all.

IV: Change in Athletic Programs

The increase in evidence associated with the prevention of sudden death in sports has provided state leaders, medical professionals, high school administrators, and coaches with important information. This information has the potential for progressive change, however in order for change to occur a school or state must be willing to make those recommended changes. Although best practice recommendations have been made at the secondary school setting for the prevention of sudden death in sport,¹⁰ state high school athletics associations or private school athletic associations often do not mandate them and as a result no change occurs.

Although it may seem like a simple task, making changes at the secondary school level is extremely difficult. In collegiate sports, they have the national governing body (NCAA) to create and enforce all of the rules however, at the secondary school although the National Federation of High School (NFHS) is in place it is very difficult for them to make mandates and enforce this upon tens of thousands of schools across the country. This means that policies must be created and enforced at the individual state, conference, or school district.⁵⁸ Secondary schools should

use positively influenced neighboring schools that are forward thinking to influence their change. For example, if a school sees that an athlete was saved from exertional heat stroke at a neighboring town because that school had previously developed a policy regarding such, it puts pressure on the other schools in the district or county to do the same. Hannan and Freeman^{58,65} express this population ecology of organizations as they need to adapt to the successful demands of the environment around them or no longer exist. This can be related to policies at the high school level because if one school does not replicate a successful policy that has saved people in the community previously, they may leave their athletes at risk for sudden death and them at risk for a law suit.

Since a lot of athletic organizations are typically institutionalized and are accustomed to doing things the way it has always been done, it takes a deinstitutionalized change to correct the issue.⁶⁶ This is because their current way of doing things may not be acceptable and a change is needed. For example, a coach may be used to practicing for 4 hours in full pads on the first day of preseason camp, however that is not regarded as acceptable anymore so a deinstitutionalized change is needed.

The Full-Integration Theory is a model that is applicable to any change in an athletic organization. This 3 stage theory as explained in Cunningham⁶⁶ is regarded as a plausible change process occurring in athletic organizations. The first stage is the *identification* stage, where the underlying issues are identified. This can be a very difficult step finding underlying problems compared to any superficial issues. Realizing that your school does not have an EAP in place and could hurt your school in the long run is an example. The second stage is the *implementation* stage and the issues that identified in the previous stage are addressed.⁶⁶ The implementation may be the most difficult because it will have the overall biggest impact. The third stage, or the

maintenance stage, focuses on reinforcing the organizational culture change.^{6,66} The importance of this stage is to ensure that the organization does not revert back to its old methods.⁶⁶ Therefore the Full Integration Theory is an efficient model that can be used by schools in order to make an important change regarding their current inadequate matters.

Proactive vs. Reactive

Changes in the secondary school setting will either come from a proactive or reactive nature. Proactive deals with gathering information or recommended policies and implementing them in your school. A reactive nature, is not uncommon in the secondary school setting, and will come from the reaction to a tragedy that occurred. If death is the topic of conversation, it is important for a proactive change to be made so the chances of a sudden death in sport can be minimized. This is obviously preferred to a reactive change but more often than not, society convinces themselves that it won't happen to them until one day it unexpectedly happens and they aren't prepared.

Being proactive is the mantra that should be emphasized when it comes to preventing any sort of tragedy however this is not done as often. Having a proactive nature is hypothesized to come from an internal force⁵⁸ but more research is needed to be more certain. A state that is being proactive in policy change will overall lessen the chances of fatalities in sports. New Jersey was proactive by becoming the first to adopt recommended guidelines for heat acclimatization,⁶⁷ even with no documented deaths from exertional heat stroke in years.⁵⁸ The change that one makes from being proactive can also foster change by others who see a need for change. More distinct information regarding policies and ways to reduce fatalities may be the missing information to increase the amount of proactivity regarding policy changes seen in secondary schools.

Reactive nature is what is seen a lot in the secondary school setting and even though a change is eventually made, a district shouldn't wait for a student athlete's death to make the change especially if simple changes could have saved that athlete to begin with. For example, the NCAA started mandating sickle cell testing for all Division I athletes in response to an exertional sickling death of Dale Lloyd II, a Rice University football player.³⁹ Previously, the NCAA recommended the testing, but as part of the case settlement and the discovered knowledge that athletes with SCT have an elevated risk of exercise-related sudden death, it became a requirement. Also, in high school, a concussion law known as the Zackery Lystedt Law was implemented in the state of Washington in response to an athlete who suffered a serious brain injury after sustaining a concussion and returned to play the same day.⁶⁸ Both situations lead to a great change at their levels, but proactivity and understanding of the available literature by the regarding organizations, could have prevented to occurrence.

Barriers to Making Change

The need for change is sometimes put on hold or not realized due to a barrier that a school may face. Many schools have stated that a lack of budget is the primary issue why they are unable to improve medical care, hire athletic trainers, or change policies.^{64,69} As reported by Wham et al.⁷⁰ most schools in South Carolina have an annual sports medicine supply budget ranging from \$1,000 to \$3,500 and a quarter of schools having a budget of \$1,000 or less. Wham⁷⁰ also found that there was a significant association between the size of the sports medicine supply budget and the level of medical care provided by a high school. The budget issue can be resolved by a change in where the money is gained. Before the mid 1990's Hawaii lacked athletic training services in public schools compared to the private schools. So the Hawaiian state legislature elected to provide funding for an athletic trainer in each public

school.^{70,71} Although hiring an athletic trainer may seem like a big budget hit to many athletic directors, it was found in that in Michigan public schools, that an athletic trainer yields a total cost savings of \$8,386 per school year.⁷² Also, in such policies like heat acclimatization guidelines that cost no money to implement, there is no reason for a school not to have such policies.

The lack of knowledge of athletic training services and what they can provide for a school has also emerged as a barrier to change and the hiring athletic trainers. Many athletic directors view the school coaches competent enough to provide proper medical coverage due to their coaching certifications. The lack of knowledge regarding the value of an athletic trainer as well as the education and training needed to become one is also very common among school administrations.⁶⁴ In a well-known case regarding the death of Max Gilpin, coaches were considered a major factor related to the death.^{73,74} In this case, he was not treated appropriately following exercising in the extreme heat. An athletic trainer was not available in this case and likely would have prevented the occurrence if they were.⁷⁴ An athletic trainer is an allied health care professional who is qualified and certified in the prevention of injuries and illnesses, recognition, evaluation, and immediate care of injuries and illnesses.² It is also required by the NATA that all athletic trainers have current certifications in CPR and AED.² This lack of knowledge of what an athletic trainer is can be justified by teaching school administrators the benefits of medical care one can convey.

Conclusion

One reason why many schools have failed to change their policies or improve their medical coverage may be due to the lack of supporting research. There is evidence to back the reasoning behind implementing EAPs, coach's education and certification in CPR/AED, hiring

athletic trainers, and implementing proper policies however, no one has properly examined secondary school deaths retrospectively to determine if the best practices were in place. By conducting a thorough examination of secondary schools that have experienced a death during high school athletics, we aim to improve upon the current evidence that suggest that medical care be in place and that appropriate prevention and treatment mechanisms should be in place in secondary school systems.

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CHAPTER II

INTRODUCTION

From 2000-2013 approximately 200 sudden deaths have occurred during sport and physical activity at the secondary school level.¹ Causes of sudden death range in this population from sudden cardiac death,²⁻⁵ to exertional heat stroke,⁶⁻⁸ head injury,⁹ and more. In an effort to determine the commonalities that predispose secondary schools to such a tragedy, researchers have identified factors such as lack of emergency action plans, lack of policies and procedures, lack of treating the athlete, predisposing factors, and inappropriate medical coverage as the critical components to the tragedies.^{3,6,10,11} Although these components have been suggested, evidence-based research related to the appropriate prevention and treatment mechanisms being conducted in the secondary school setting is lacking. For example the largely publicized case of Max Gilpin, a high school football athlete from Kentucky who died of an exertional heat stroke in 2008, identified with many of the factors previously mentioned.¹¹ The case of Max Gilpin in particular had no emergency action plan, no procedures in the event of a collapsed athlete, little to no knowledge by the coaches about emergencies or medical conditions, and no medical coverage at the time of the incident. An extensive review of this case would bring one to the conclusion that perhaps had an athletic trainer (whose job it is to prevent, diagnose and treat, and educate others about sport related injuries and emergency conditions) been present that Max's death might have been prevented.¹²

Research focusing on the prevention of sudden death in sport conducted at the Korey Stringer Institute and funded by the National Athletic Trainers' Association (NATA) has identified that 70% of the 8,509 public high schools surveyed in America have medical services in the form of an athletic trainer in some way, however only 37% and 31% are employed full

time and part time, respectively. With 30% (2,579) of the public schools identifying that they have no athletic training services and 31% (2,619) hired only part time, this leaves countless practices and games with little to no medical care. In these circumstances where no medical care is present, young athletes are left in the hands of a coach who may or may not have attended a medical training presentation and who is expected to know from one 8 hour session how to properly treat emergency conditions that often present very similarly.¹³ This situation forces parents to unknowingly permit their child to participate in sport day after day without proper medical care. In response to tragedy all across the country, secondary schools are hiring athletic trainers to ensure the safety of the athletes, educate coaches, parents and players, implement sudden death prevention strategies, and provide emergency services.¹³ Athletic trainers' are the most qualified medical providers during athletic participation to appropriately handle sudden death situations such as cardiac arrest, exertional heat stroke, and head and spine injuries. All of which are among the most common types of sudden deaths on sport fields.¹⁴ To date no research currently exists examining sudden death at the secondary school level to determine if an athletic trainer was present during these situations, and furthermore if emergency action plans, best practices for emergency treatment, and state policies were followed at the time of the death. Up to the present time no research has investigated if secondary schools have made improvements to their health and safety practices and/or modified their policies and procedures since the death of an athlete at their school. This information will provide knowledge of what policies and procedures related to emergency planning were lacking at the time of the incident as well as what their course of action was to change following the death.

The primary purpose of our research was to gain a more in-depth appreciation of the circumstances related to the sudden death of student athletes at the secondary school setting. Our

study was guided by the following questions: 1) what was the extent of the medical coverage provided in each case of sudden death, 2) were emergency action plans (EAPs) in place at the time of death and were they implemented at the time of the condition, and 3) what changes occurred within the secondary school itself in response to the sudden death.

CHAPTER III METHODS

Research Design

Our mixed methods study included 3 Phases to gain a purposeful sense of the sudden deaths that occurred within the secondary school setting. Phase I: brief phone questioning, Phase II: online open-ended questionnaire using Qualtrics™, and an optional Phase III: in-depth semi structured phone interview (Figure 1). We selected this methodology as we aimed to explore sudden death from the perspective of the administrators or individual(s) who were directly involved in the death. Exploratory qualitative research¹⁵ allowed us to make connections regarding the experiences of these individuals who were involved in a specific experience (i.e. sudden death due to sport participation). The questions for each phase were developed to build up throughout the study. Phase I used basic questioning regarding the sudden death, while phase II and III used those questions to delve further into the death. Prior to the start of data collection the questions were previewed and tested by researchers who provided input to ensure the most efficient questions were developed.

Recruitment of Participants

The inclusion criteria included: 1. Athletic directors, upper level Administrators, or employees of secondary schools who were present and/or have knowledge of the sudden death situation that occurred in their respective school during organized sport. 2. Secondary schools that experienced a sudden death in sport must have been identified in the database obtained and managed by the National Catastrophic Center for Sports Injury Research, University of North Carolina at Chapel Hill, NC or the online Sudden Death Registry database at the Korey Stringer Institute at the University of Connecticut, Storrs, CT. During our screening process, we excluded any sudden death that did not occur during or in direct relation to specific school-related

activities. We elected to exclude non-school related activities because the intentions were to focus on sudden deaths from secondary school sports participation. We also decided to exclude athletic directors and/or upper level administrators at secondary schools who were not present and/or had no knowledge of the sudden death situation that occurred in their respective school during organized sport were excluded from participation.

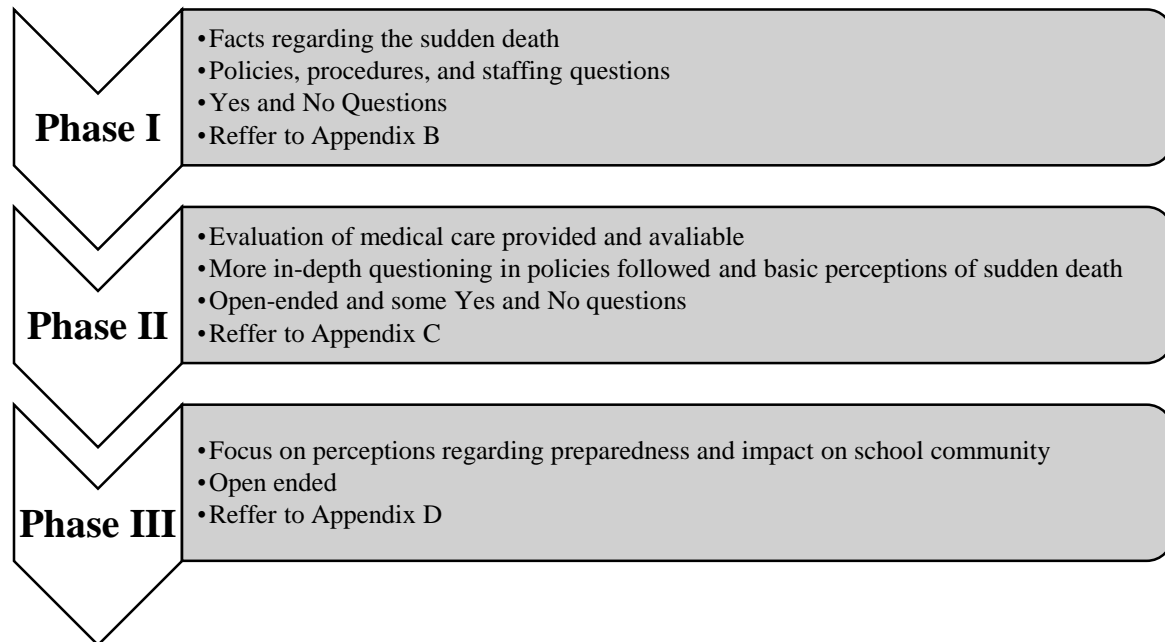


Figure 1. Data Collection Procedures

Data Collection Procedures

Data collection commenced in May of 2015 following approval by the University of Connecticut Institutional Review Board (IRB). Once approval was obtained the National Center for Catastrophic Sport Injury Research (NCCSIR) provided us with the names of the secondary schools that experienced a sudden death at the secondary school level from January 1, 2000- June 30, 2013. The schools were then cross-referenced for contact information using online sources and phone calls were placed to each school to identify a school official or employee

(athletic director, principal, athletic trainer, or coach) who had knowledge of the situation. In addition to the phone call, emails were distributed to various school administrators. In both methods of recruitment the purpose of our study was explained and consent was obtained. If participants consented over the phone they were asked to answer a few initial questions regarding the incident (see Appendix B, Phase I Phone Script) or were given a number to contact via email to start the study (see Appendix G, Phase I Communication via Email).

Within 24 hours of completion of Phase I the student investigator sent a link to the participant and they were asked to complete an online questionnaire at their convenience (see Appendix C, Phase II Online Questionnaire). If they had not completed the online portion within 2 weeks of the initial phone call, another email was sent reminding them to participate. If 4 weeks after the initial phone call they had still not completed the online phase, a final email was sent reminding them to participate. At any time during the study, if the participant stated that they would not like to participate in the study, they were removed from the email and contact list. The first page of the Phase II online questionnaire was a consent form that allowed them to accept and continue, or decline and not finish the questionnaire. The last question of the online portion gave the participant the option to continue on to Phase III, which entailed an in-depth semi structured phone interview (see Appendix D, Phase III Phone Script). The timeline for our collection can be seen in Table 1.

All phases of the survey were anonymous and the data was linked together using a pseudonym provided to each subject prior to the start of our study. The interview was scheduled for a time that worked best for the participant and the researcher who conducted the phone interview. The interview identified the emergent themes surrounding their perception of the policies, treatment, and care of each sudden death case. We capitalized on the strengths of each

method, in the hopes to neutralize their weaknesses. The Qualtrics™ instrument provided objectivity in precise measures; while the phone interviews afford flexibility and the opportunity to delve further into the experiences of our participants. Phone interviews were recorded and transcribed verbatim prior to multi-analyst triangulation for identification of themes.

Study Timeline	
Stage	Time Frame
Obtained data from NCCSIR	April 2015
Began calling secondary schools (Phase I)	May 2015
Sent online questioning (Phase II)	Within 24 hours of Phase I completion*
Scheduled phone interview (Phase III)	Within 1 week of Phase II completion*

Table 1. Timeline of our data collection from obtaining data until completion of respected phase

*Based on the number of schools called these steps were on a “rolling enrollment basis” depending on the number of successful calls completed during Phase I and the number of participants who agree to be contacted for Phase III.

Data Analysis

For our phase I data during the phone calls, researchers manually entered the yes or no answers to the questions outlined in Appendix B into an excel sheet for later analysis while in Phase II data we exported the survey responses utilizing the export to csv. function in Qualtrics where values were coded for the responses selected by the participant. Data for both Phase I and II were analyzed using Microsoft Excel for Mac Ver. 2015. Phase III data was analyzed following a general inductive, basic content analysis to examine trends and patterns in participant responses. We used an open coding procedure to identify key themes dealing with the open-

ended data. Similar responses were placed into categories, which then became the themes of our phase III data.

Data Credibility

To determine credibility of the data we used investigator and methodological triangulation.¹⁵ Our research team included 3 members, two faculty members and a graduate student. Each member of the research team used their understanding of sudden death in sport, research methods, and athletic training as a means to reduce bias during collection of the data and subsequent analysis of the data. The idea of multiple researchers is to help reduce “blind spots” and illuminate the commonalities that can emerge in the research process.¹⁶ We triangulated our sources as well by collecting data in phases, as well as including questions that were structured (yes vs. no) and open ended and probing.

CHAPTER IV RESULTS

Study Participants

Out of the 279 sudden deaths that occurred in the secondary school setting in the United States between January 1, 2000 and June 30th, 2013, which were retrieved from NCCSIR, the total number of completions for each section is displayed in Figure 2. During our data collection, some schools declined participation due to information is still baring legal agreements and many denied participation with no reasoning.

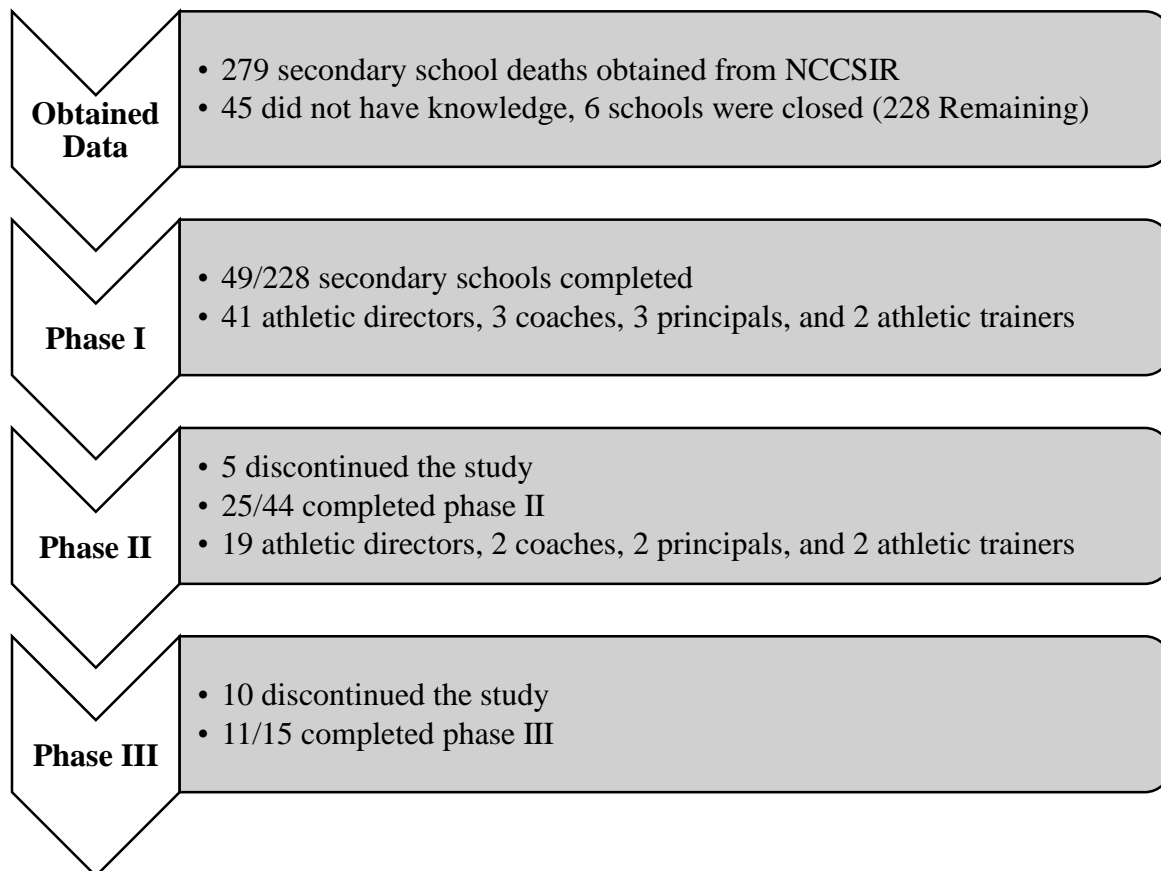


Figure 2. Participants for each phase of the study

Death Demographics

The total 279 deaths were looked at as a whole to make comparable demographic information. The following tables will show the breakdown of the sudden deaths in various perspectives. Table 2 represents the sport vs. sex totals of the sudden deaths, Table 3 represents the causes of death by gender, and Table 4 shows the number of deaths in relation to practice, competitions, or scrimmage.

Sport	Female	Male	Grand Total
Baseball	0	14	14
Basketball	4	43	47
Cheerleading	6	0	6
Cross country	7	8	15
Drill team	1	0	1
Field hockey	1	0	1
Football	0	131	131
Ice hockey	0	3	3
Lacrosse	0	5	5
Soccer	3	12	15
Swimming	2	3	5
Tennis	0	2	2
Track	2	18	20
Wrestling	0	14	14
Grand Total	26	253	279

Table 2. Deaths by sport: male, female, and grand total

Sudden Death	Female	Male	Grand Total
Asthma related	1	5	6
Brain aneurism	1	3	4
Brain ateriovenious malformation	0	1	1
Brain hemorrhage/hematoma	1	26	27
Brain traumatic injury	0	6	6
Cardiac arrest	18	121	139
Cardiac arrhythmia	0	4	4
Cardiac cardiomyopathy	1	15	16
Cardiac commotio cordis	0	4	4
Cardiac congenital other	1	12	13
Cardiac myocarditis	1	1	2
Cardiac undetermined	0	2	2
Heat stroke	0	28	28
Hereditary spherocytosis	0	1	1
Illness MRSA	0	1	1
Internal organ injury	1	4	5
Lightning	0	2	2
Lower leg embolism	0	2	2
Neck fracture	0	4	4
Neck ruptured blood vessel	0	2	2
Seizure	1	1	2
Sickling event	0	2	2
Skull fracture	0	1	1
Spine fracture	0	1	1
Throat internal injury	0	1	1
Undetermined/unknown	0	3	3
Grand Total	26	254	279

Table 3. Causes of death by gender and grand total

Sport	Competition	Practice	Scrimmage	Grand Total
Baseball	2	12	0	14
Basketball	23	23	1	47
Cheerleading	2	4	0	6
Cross country	8	7	0	15
Drill team	0	1	0	1
Field hockey	0	1	0	1
Football	44	85	2	131
Ice hockey	3	0	0	3
Lacrosse	2	3	0	5
Soccer	6	9	0	15
Swimming	3	2	0	5
Tennis	2	0	0	2
Track	2	18	0	20
Wrestling	5	9	0	14
Grand Total	102	174	3	279

Table 4. Number of deaths in competition, practice, scrimmages, and totals

Phase I and II

During phase I of our study, secondary school participants were asked if an athletic trainer was present, did they have an emergency action plan and was it followed, and if they coaches were certified and trained in CPR and AED. Our results are diagramed in Table 5.

Surveyed Predisposing Components	Percentage of Findings	Respondents
No athletic trainer present	71%	35/49
Issues with EAP (<i>i.e. not following or lack thereof</i>)	39%	19/49
Coaches are deficient in CPR/AED Training	16%	8/49

Table 5. Relation of the supposed predisposing condition to the sudden deaths from Phase I

(n=49)

Years on Staff	Frequency of Responses	Years Certified	Frequency of Responses
1 Years	1	1 Years	0
2-4 Years	5	2-4 Years	3
5-10 Years	2	5-10 Years	2
10+ Years	3	10+ Years	6

Table 6: The number of years on staff and years certified for the onsite athletic trainers for the sudden deaths. (11 responses)

A majority of the secondary schools that participated in phase I had an EAP in place at the time of the incident 31/49 (63%). Our participants who reported having an EAP believed they, 30/31 (97%), followed it correctly on the day the death occurred. As well, it was found that of 31 who had an EAP available, 22 schools (71%) had an athletic trainer on staff to create the plan. Out of the 18/25 (72%) who reported having an EAP in place in phase II, it was found that 11 (61%) of the schools properly trained and made their coaches aware of the EAP, where the other 7 (39%) made their coaches aware but did not properly train them on their EAP's at the time.

The perception on what was thought could have prevented the death was identified in Phase II (n=25). Table 7 represents the available responses when asked if they thought it could have been prevented. The 18 responses for "Other" were, 1 (4% of total) for more understanding, 1 (4% of total) for not to be cleared from the doctor, 2 (8% of total) for having an AED present, 3 for diagnosis of an unknown condition, and 11 for unpreventable. For the school employees who responded that the death was not preventable, it was found that only 2/11 (18%) had an

athletic trainer present at the time of death. The correlation between the type of death and thoughts that it could have been prevented were not made.

Hiring of Medical Staff (Athletic Trainer)	Inform Coaches With Information about Medical Emergencies	Inform Players With Information about Medical Emergencies	More In-Depth Emergency Action Plans	Yearly Overview of Policies and Procedures With Staff	Other	Care Not to Answer
8%	4%	0%	20%	4%	18 Responses	8%

Table 7. Ideas on preventing the sudden death developed from responses in phase II

It was found in phase II of our study that many, 21/25 (84%) had made a change in reaction to what occurred inside their respective schools. The changes that were seen in result of the death can be in Figure 3. The “Other” changes described varied. Two increased the number of available AED’s, one had a state law created due to the case, one school added a policy regarding heat practices, and one was not able to provide that information.

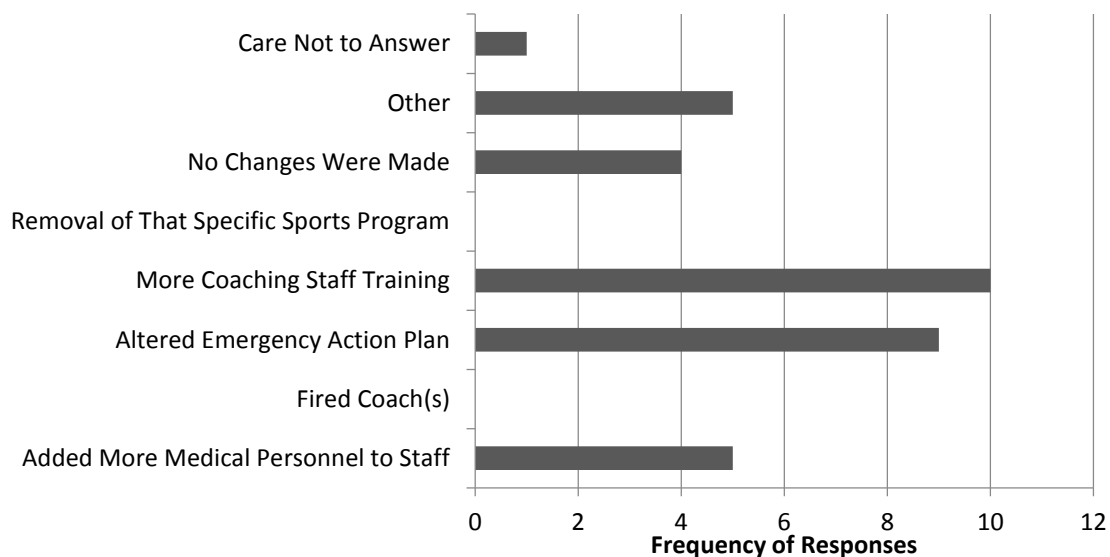


Figure 3. Reactive changes made post death in the respective secondary school

Phase III

When looking at each sudden death in the secondary school setting, a few dominant themes had emerged from our phase III data (n=11, 7 athletic directors, 2 principals, 1 athletic trainer and 1 coach): The death was a devastating impact for the family, school, and community, the school employee's false sense of security is contrasting, and in the reactive nature changes occur within the school post death. Changes post death took different routes in some of the situations. For some schools the death resulted in a policy changes, while others changed medical coverage (resulting in their satisfaction in their medical care). Last, others noted an emotional change around the school. Figure 4 depicts the emergent themes and sub-themes from our Phase III data in response to the sudden death. The breakdown of responses from our 11 participants that completed the study is presented in Table 8.

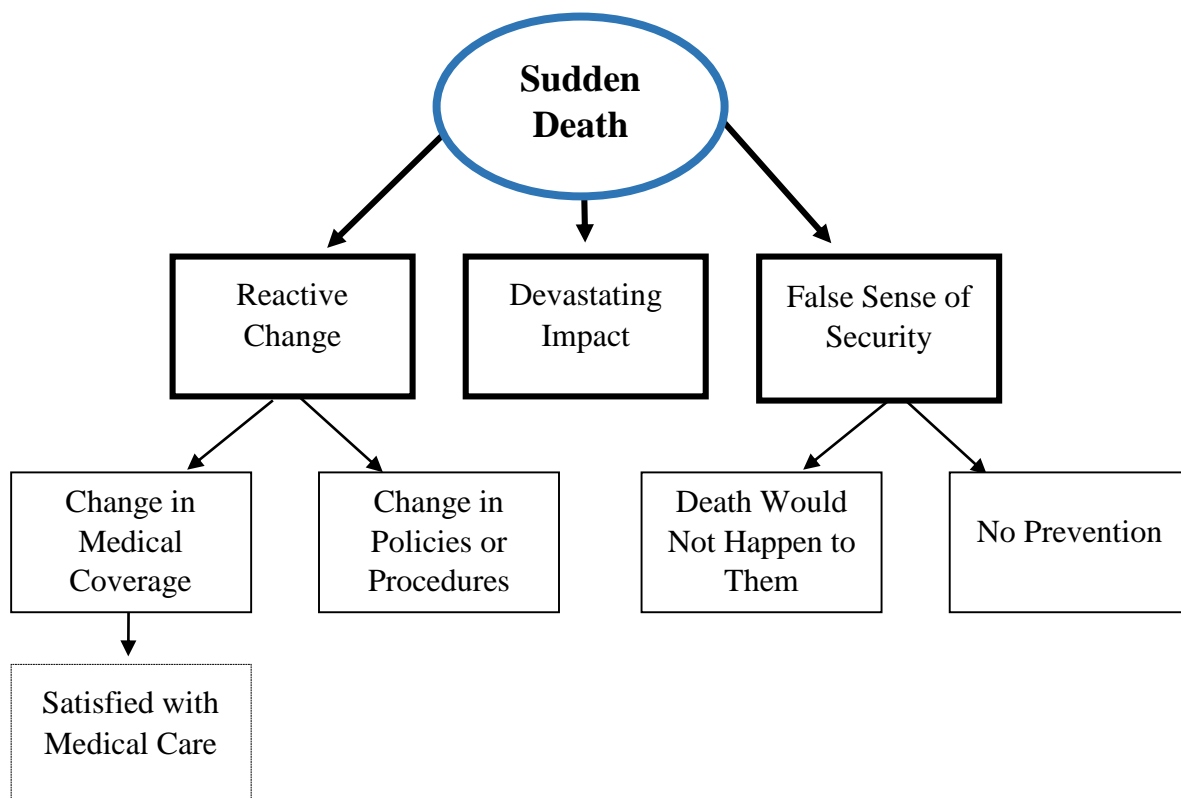


Figure 4. Themes developed around a sudden death in the secondary school setting

		Sudden Death Case											Totals
		1	2	3	4	5	6	7	8	9	10	11	
Phase I/II	1. Athletic trainer present				x			x					2/11
	2. Emergency Action Plans followed		x	x				x			x	x	5/11
	3. Coaches trained and certified in CPR/AED			x	x		x		x	x		x	6/11
Phase III	4. Devastating Impact on Community	x	x	x	x	x	x	x	x	x	x	x	11/11
	5. Thought it could have been prevented in another way					x		x			x		3/11
	6. Changes were made		x	x		x	x	x	x	x	x		8/11
	a. Changes in policies		x	x		x		x	x	x	x		7/11
	b. Addition of medical coverage		x	x						x	x		4/11
	7. Thought they were prepared	x	x		x		x	x			x	x	7/11
	8. Thought that it would never happen to them	x	x	x	x	x	x	x	x	x	x		10/11
	9. Thought there could have been improvements that day					x		x	x	x	x		5/11
	10. Satisfied with current medical care		x	x	x		x	x		x	x	x	8/11

Table 8. Prevalence of the corresponding questions from phase III in our 11 sudden death cases

Reactive Changes Post Death: It appears that all of the participants were impacted greatly from the fatality and resulted in changes made in 8 out of 11 of those secondary schools that completed phase III. *“We have much better procedures in place than we did at that point in time”* was said by an AD and *“We have done a lot of work with CPR and AED training for folks”* was also said by another AD we interviewed. An AT said, *“We have gone to training all of our coaches in CPR... and increased the number of AEDs we have.”* The addition of medical coverage was key for many schools, *“I’m not sure how long ago we got (athletic) trainers put in our school, but it has been a great thing for us”* said one AD. The policy changes and medical coverage addition post death were common, however the changes that dealt with community showed the most support. *“We now certify all of the students in CPR”, “We have a memorial garden in front of the school put in his honors”* and *“A swim meet in their honor with services that do a heart check for the athletes.”* Those are 3 lines from 3 different participants on the change that had occurred around the secondary school due to the fatality.

Satisfied with Current Medical Care: The perception of their current medical care demonstrated strong support for the need for athletic trainers. Examining our interview responses from Phase III, it was found that 8/11 schools are satisfied with their current medical care. All 8 of those schools that are satisfied with their current medical care also employ an athletic trainer. In retrospect, the 3 schools that are not satisfied with their current medical care do not currently employ an athletic trainer. One AD said *“Our (athletic) trainer is phenomenal, he is a rock star. If there is anything medical related he’s my go to guy... He is a crucial piece to our athletic program here”* and another AD saying *“If anyone ever decided to get the (athletic) trainers out of our high school then I would fight it a lot.”* One other AD put in his input about his athletic trainer saying *“... it’s a good feeling knowing that we have somebody that’s so capable to handle*

those situations.” While some were very pleased, some were hoping they were in the same scenario saying “I would love to have an athletic trainer... not only for the emergency situation, but just from the ongoing improvement for our athletes... but we keep coming back to that funding conundrum.”

Devastating Impact: A general consensus (11/11) could be found among our participants regarding the impact the fatalities had on the secondary school’s community, which was perceived to be devastating. All of our participants described the impact as upsetting. For example, one of our participants a Principal said it was *“a heart wrenching experience”* while an Athletic Director (AD) considered it to have *“a very large impact that we are still dealing with today.”* Our participants described the sudden death as something that reached beyond the family and friends of the athlete, but also included the school community. One AD considered it a *“life changing for everyone around”* and another saying, *“we felt like we lost a part of our family.”*

False sense of security: The data also demonstrated that the majority of the time (10/11, 91%), perception of sudden death occurring at the secondary school did not match the reality of the school employee. Responses regarding the realities of the incident revealed that many did not suspect a sudden death would occur in their community. For instance, one AD had shared *“that (sudden death) is never going to happen”* while another, AD, said *“No, never in a million years (did I think it could happen to us).”* A principal said *“I went through all that training, but you never think that you’re ever actually going to use it”* and the sad but true reality of the statement that was given by one AD is not very securing, *“Glad it happens someplace else.”* The AT who thought that it could happen to them stated, *“I have been doing this long enough to know that no school is immune from something like this happening.”* This is a prime example of the mindset of the AT whose job it is to be prepared for these situations and put the proper steps in place.

When a false sense of security or perception of reality is present, often steps are not taken for the very reason that they don't believe that it will ever happen to them. As well as ones not suspecting the death, 8/11 schools employees who were surveyed in phase III perceived that it could not have been prevented. One Principal stated *"If we had done it 100% perfect, saving seconds, it wouldn't have made a difference"* and another AD stated *"I don't think any more preparedness would have helped us."* In some situations like this, they might not have the knowledge that many sudden deaths are preventable with proper protocols and support.

CHAPTER V

DISCUSSION

In our study, we examined the extent of the medical coverage and determined if EAPs were in place and implemented during sudden deaths at the secondary school level between January of 2000 and June 30th of 2013. Furthermore, we aimed to determine if changes occurred and in what capacity, in secondary schools who experienced a sudden death. Recent studies have identified factors such as lack of emergency action plans (EAPs), lack of policies and procedures, and inappropriate medical coverage as critical components to the tragedies,^{3,6,9,10} but high quality research related evidence surrounding sudden death situations is lacking. The secondary school level experiences the highest amount of athletic related deaths compared to young adults,¹⁷⁻¹⁹ and it has been found that some are preventable with proper recognition and treatment.⁹ This population needs a better view of what preventable factors will decrease recent numbers. The results of this study demonstrate that athletic training services were not the primary medical care present during many deaths. This supports the current literature^{3,9,14} that suggests improper medical care as a primary predisposing factor to sudden death. As well, the results portrayed that the death has a strong enough influence and impact on the school that many made a reactive change to hopefully better them for the future.

The causes of death and the rates by sport and level of activity of the sudden deaths included in this study are similar to the literature that currently exists regarding the leading causes of death in sport.¹⁴ In our study, 65% of the sudden deaths were cardiac related, 14% were the result of a catastrophic brain injury, and 10% were due to an exertional heat stroke (refer to Table 3). These 3 causes of sudden death have been labeled as the most common types in sport.¹⁴ The sport in which the death occurred was consistent with previous literature as well. Football, which has been shown to have the most sudden deaths,¹⁹ demonstrated the highest percentage

(47%) in our study as well (refer to Table 2). The level of activity in which the death occurred in our study was 37% being during competition, 62% during practice, and 1% during a scrimmage (refer to Table 4). This may possibly show that the increased medical coverage and importance in a competition situation may vary the results as it relates towards sudden death and how it can be correlated to everyday practice.

Athletic Training Presence: The schools that had participated revealed that in 71% of the fatalities an athletic trainer was not present for medical coverage (Table 9). Which associates to previous research that states approximately 50% of secondary schools do not have medical staff present on site to implement the policies related to a certain condition.²⁰ Therefore, some student-athletes did not have the best on-site medical coverage as outlined by recent NATA consensus and official statements.²¹

Athletic trainer present at time of death	Yes	No
n=49	29%	71%

Table 9: Deaths that had athletic trainer present vs. those that did not.

Without appropriate medical personnel present at an athletic event, the athletes are being placed at a higher risk for sudden death when there is no athletic trainer in attendance to respond to the situation. The Max Gilpin case is again a prime example^{11,12} where an athletic trainer was not available for treatment, resulting in inappropriate care, and eventually death for the young individual. Not having an athletic trainer present leads to a large amount of pressure, responsibility, and liability on the coaches and the school.²⁰ This places additional stress on the need for appropriate medical staff, (i.e. athletic trainer) at all athletic events. It would be false to assume that the deaths of all of the athletes that did not have an athletic trainer present would have been saved, but if an athletic trainer has been shown to provide the most effective care and

71% of our studied individuals did not have one present, there could be a strong correlation between the two. Future research and reporting of “lives saved by ATs” can help to make a stronger evidence-based argument to fully elucidate whether or not sudden death is less likely when an athletic trainer is present.

The medical care for a school has a big impact on the overall wellness of the school. Not only from the medical standpoint which was just stated, but the perception standpoint as well. 100% of our tested subjects that stated they were satisfied with their current medical care had at least 1 athletic trainer on staff. Budget and other factors that have been determined to be the major barriers when hiring athletic trainers in the secondary school setting.²² Until further outcomes based research demonstrating the cost-benefit of athletic training services emerges, schools that remain without proper medical care will remain unsatisfied with their medical coverage, as described in the current study. If athletic trainers play a key role in the satisfaction of a schools’ medical coverage and the overall health of the athletes in both emergent and non-emergent situations, why do upper level administrators continue to disregard the medical expertise and value that an athletic trainer brings to a school and push for them to be included in the budget? Numerous high profile athletic trainers have gone on record stating that “if you can afford to field a football team, you can’t afford not to have an Athletic Trainer.”

Impact of Policies and Procedures: Our aim was to determine the percentage of schools that had an EAP in place and correctly followed on the day of the incident. It was found that the EAP was in place and followed 63% of the time. Although the majority of schools provided an EAP, this did not correlate to what was decided in *Kleinknecht v Gettysburg College in 1993*,²³ stating an institution owed a duty to each athlete to provide an emergency plan that was adequate for the risks involved in sport participation. In previously reported cases that were described by

Courson,²⁴ it was shown that the proper use of a well-constructed EAP in an emergency situation can end in smooth positive results however, in most of our cases where an EAP was utilized, a different result was found. More research regarding the correlation between EAPs and sudden death at the secondary school level is needed.

Changes in the Secondary School Post Death: Changes at the secondary school level must be made and enforced at the individual state, conference, or school district.²⁵ The National Federation of High Schools (NFHS) currently serves as a federation for high schools across the country, however it is difficult for them to make changes and mandates to all of the secondary schools due to a lack of feasibility for all schools to comply. Based on our phase III data, 73% of the time change occurs following a sudden death incident. The change in 4/11 of our Phase III participants reported that they or the school, made a change in adding medical coverage such as an athletic trainer. Furthermore, in response to the fatality 7/11 made a change to their EAP policies and procedures. Both of these changes were reactive in nature, which has been seen to be common among this level regarding policy and sports medicine standpoint.²⁵ Previously this was seen in the state of Washington, when the Zackery Lystedt Law was implemented in response to an athlete who suffered a serious brain injury after sustaining a concussion and returned to play the same day.²⁶ This law created great change in that state, but proactivity and understanding of the available literature by the regarding organizations could have prevented the occurrence. A proactive change by secondary schools using models such as The Full-Integration Theory²⁷ (an efficient 3 stage model that can be used by schools in order to make imperative changes regarding inadequate matters) would be more beneficial than a reactive change that is results from a death of a student. Reactivity however, can still be positive if it leads to a safer

environment for the future, but unfortunately it means that at least someone had to suffer a death as some point.

Perception of the School Administrator: Perception of the school administration plays a big role in the medical standpoint of the school. As described in the results section, all but one of our participants (10/11) didn't believe a sudden death would ever occur at their school. It has already been described that almost 40% of life threatening injuries by children age 6-18 were sport related,¹⁸ so the common perception that was seen may actually be a misperception of the truth. As well as the misperception of schools believing it would not happen, in retrospect 44% believed that it could not have been prevented. It is understood that in certain situations, even the most qualified individuals may be unsuccessful in saving an athlete during a life-threatening scenario, but sometimes a lack of knowledge regarding what could have been done can confound what an individual thinks and falsely represent what they perceive could have been done. To increase the chance of survival in an emergency, an athletic trainer has been recommended to be employed in all high schools with an athletic program and are deemed the most effective with medical care at this level.²⁸ The perception of the school administrator on athletic trainers capabilities is lacking²² and only 8% of our total participants thought an athletic trainer could have helped prevent the death from occurring, when they have been valued as the most qualified medical providers to deal with sudden death situations such as cardiac arrest, exertional heat stroke, and head and spine injuries.¹⁴ The correlation between the actual cause of death and the post death perception was not made.

Limitations: We must recognize that there were limitations to this study. One was the response rate from our participants. Although all were called and emailed numerous times, we did not end up with a response rate that we were expecting. One reason may have been due to the

turnover rate of employees at these schools and since we are looking at deaths that happened between January 01, 2000 and June 31, 2013, staff members from the time of death were not always employed at the school and their contact information was not always available. Another limitation was with the clarification of what a written EAP's was considered. One participant when asked if they have an EAP in place at this time, responded back with *"Yes, Call 911."* From that statement, and other seen confusion there can be made question on what some considered a valid EAP for when they asked if they had one in place. A clarification of what a well-constructed plan is, might have given us different results.

Future Research: Future research is needed to figure out the extent of the factors that came into play for each one of the schools that did not respond. A higher response rate will give us a better look at the data regarding medical coverage, policies, and perception of an insider from these sudden death situations. Having the largest amount of data will lead to the most accurate information regarding the predisposing factors will help find the ways to prevent reoccurrence. Also, in this study, it was looked at the situations where a death occurred, future research will greatly benefit from the knowledge of policies, coverage, and perception of schools who had a student athlete in an emergency situation and lived. Gathering information from both sides of the spectrum will lead to great knowledge regarding this subject.

Conclusion: Although a common misconception, no school is immune from sudden death at the secondary school level. During our study it was shown that athletic trainers were not present for 70% of the sudden death situations surveyed at the secondary school setting. Given the scope of practice of an athletic trainer and their role in the emergency preparation and planning to mitigate sudden death, there may be a correlation between the lack of an athletic trainer present and an increased chance of sudden death in the secondary school setting, however

because we are unable to include those potential sudden death scenarios that were prevented by having an athletic trainer or “saves” we are unable to provide strong evidence that athletic trainers prevent sudden death. The misconception of sudden death and athletic trainers may be the reason that we see a reactive change from the death more commonly than a proactive change for the future.

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Appendix B: Phase I phone script

Phone Script:

Hello, my name is _____ and I am calling from the Korey Stringer Institute at the University of Connecticut may I please speak with the Athletic Director or Principal? **AT or Coach if not available.**

Hi Mr./Mrs. _____ my name is _____ and I am calling from the Korey Stringer Institute at the University of Connecticut and we are conducting a research project examining schools that have experienced a sudden death during sport or physical activity.

- We serve as experts in the prevention of sudden death in sport here at KSI and this project aims to develop an understanding of the underlying factors that predispose an athlete to death in the secondary school setting.
- Participation is anonymous and at no time will the information be used for any other purpose.
- If you are willing to participate, we would like to ask you a few quick questions regarding the incident that occurred at your school. It will take approximately 2 minutes of your time.

In excel sheet please code all **YES** responses as 1; and **NO** responses as 0. Provide details in notes section.

If **NO**...thank them for their time and hang up.

If **YES**...Continue on to questions below

1. Were you the _____ on the date of the occurrence and would you be able to provide general information about the incident involving (insert player name) on (insert date of incident)?

If **YES** ...continue on to question 2 or obtain contact information for the individual they refer you to.

- a. If **NO**do you have enough knowledge to answer some basic questions about the medical care in place on that day or is there someone else that you could refer us to that would be able to answer these questions?
 - b. If **NO**...thank them for their time and hang up.
2. Was an **Athletic Trainer employed** at the school at the time of the incident?
 - a. If **YES** ...was the AT present at the time of the incident?
 - b. If **NO** ...what was the medical coverage at the time of the incident such as an EMS, nurse, Physician, Paramedic, combination or none?

3. Were there any **sport-specific EAPs** in place at the time of the incident?
 - a. If **YES** ...Was the EAP followed on that day?
 - b. If **NO**Does your school currently have EAPs?
4. Were the coaches trained and certified in first aid and CPR/AED at time of the incident?
 - a. If **YES** ...did they utilize this training?
 - b. If **NO**...are they trained now?
5. Were you aware of your state athletic association policies and/or state laws at the time of the incident?
 - a. If **YES** ...where did you receive this information?
 - b. If **NO**...are you aware now?

Based on the information that you have shared with me thus far and to better understand how we can prevent these tragic things from happening in the future, we would like for you to complete a quick survey online. This survey will go into more detail regarding the medical care and reasons surrounding the policies in place at the time of the incident? Per University guidelines the survey is entirely anonymous and your information will be de-identified. Can you provide me with an email where I can send the survey?

- a. If **NO**...thank you for your responses and we understand.
- b. If **YES** ...say thank you and insert email into spreadsheet and send email within 24 hours.

Appendix C: Phase II Online Questioning

Sudden Deaths in the High School Setting

Thank you for agreeing to participate in our research project examining the medical coverage, emergency action plans, policies, treatments, and predisposing factors of sudden death cases in secondary school setting between January of 2000 and July of 2013. In this study, we are asking you to complete the set of given questions to the best of your knowledge and ability to provide us with the most suitable answers to the questions. Participation will take approximately 15 minutes. Your participation in this study is completely voluntary; however it is very important for us to learn your opinions. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you may withdraw at any point in time. Your responses will be strictly confidential and data from this research will be reported only in the aggregate. The Institutional Review Board of the University of Connecticut has approved this research. If you have questions at any time about the completion or the procedures, you may contact Stephanie Mazerolle at stephanie.mazerolle@uconn.edu. Thank you very much for your time and support. Please start with the first question now by clicking on the arrows.

Please select the medical coverage on the day in which the incident occurred?

- ☐ Certified Athletic Trainer (1)
- ☐ Ambulance/ Emergency Medical Services (EMS) (2)
- ☐ Paramedic (3)
- ☐ Sports Medicine Physician (4)
- ☐ Physician (5)
- ☐ Nurse (6)
- ☐ Volunteer Medical Professional (7)
- ☐ None (8)
- ☐ Other (9) _____

What was the experience level of the Athletic Trainer on scene? How many years were they an official certified Athletic Trainer?

- ☐ 1 Year (1)
- ☐ 2-4 Years (2)
- ☐ 5-10 Years (3)
- ☐ 10+ Years (4)

How many years were they employed with your school?

- ☐ 1 Year (1)
- ☐ 2-4 Years (2)
- ☐ 5-10 Years (3)
- ☐ 10+ Years (4)

At the time of the incident, were there emergency action plans (EAPs) in place?

- ☐ Yes (1)
- ☐ No (2)

At the time of the incident were the EAPs followed?

- ☐ Yes (1)
- ☐ No (2)

At the time of the incident, were all coaching staff aware that EAPs were in place and received training at least once a year?

- ☐ Yes, Coaches Were Aware of EAPs and Trained (1)
- ☐ Yes, Coaches Were Aware. No, They Were Not Trained (2)
- ☐ Neither (3)

Based on the Medical Coverage present at this incident, to what extent was emergency care provided?

- ☐ Basic First Responder (Including: Vital Signs, Airway Management, Rescue Breaths, CPR/AED) (1)
- ☐ Advanced Emergency Care (Including: Advanced Vital Signs, Assessment, Diagnosis, Evidence-Based Treatment) (2)
- ☐ Drug Administration (Including: Epi-pen, Inhaler, Intra-Venous Line, Injection) (3)
- ☐ No Emergency Care Provided (4)

Based on your medical knowledge, do you feel that the medical treatments performed were appropriate?

- ☐ Yes, In my opinion, Treatment was appropriate (1)
- ☐ No, In my opinion, other treatments should have been provided (Please List) (2)
- ☐ Very Limited Medical Knowledge (3)

What factor(s) do you feel lead to the incident? Select all that apply.

- ☐ Athlete Placed Themselves at a Greater Risk (1)
- ☐ Lack of Knowledge (2)
- ☐ Lack of Medical Care (3)
- ☐ Negligence of Staff (4)

Before the incident occurred, what could have been done more efficiently to prevent it from happening? Select all that apply.

- ☐ Hiring of Medical Staff (Athletic Trainer) (1)
- ☐ Inform Coaches With Information of Medical Emergencies (2)
- ☐ Inform Players With Information of Medical Emergencies (3)
- ☐ More In-Depth EAPs (4)
- ☐ Yearly Overview of Policies and Procedures With Staff (5)

What changes has the administrator made since the death? Select all that apply.

- ☐ Added More Medical Personnel to Staff (1)
- ☐ Fired Coach(s) (2)
- ☐ Altered EAPs (3)
- ☐ More Staff Training (4)
- ☐ Removal of That Specific Sports Program (5)
- ☐ No Changes Were Made (6)
- ☐ Other (7) _____

Do you feel like an Athletic Trainer is a necessity at every high school?

- ☐ Yes, Why (1) _____
- ☐ No, Why (2) _____

If you feel like you could not get all of your information out on this and would like to discuss in more detail, an extra phone interview is available. If interested please leave an e-mail address you can be contacted at to set up a date and time. By submitting your email you agree to the consent and agree to be contacted about participation in the phone interview. Thank you for your time and participating in this study.

- ☐ Yes I would like to continue onto phase 3 of the study and I agree to the consent. Email: (1) _____

No, I do not wish to be further contacted. (2)

Appendix D: Phase III Phone Script

Information Section Read to Subject:

Phase III of our survey will act as a semi-structured open-ended question interview. Questions will be based off of the responses to the questions in the previous 2 phases and as well off of the responses during this interview. The questions will be similar to such:

1. What was the impact of this experience to yourself and the school?
2. What advice would you give others to help prevent this from happening in their schools?
3. You hear this happen to schools around the country, did you think this would happen at your school?
4. Was the school and yourself prepared for this to occur?
5. What could have been done better?
6. How satisfied are you now with your current medical care?
 - a. What elements specifically?

Appendix E: Summary for National Center for Catastrophic Sport Injury Research (NCCSIR) Approval

The Examination of Medical Coverage, Emergency Policies and Procedures, and the Implementation of Prevention Strategies Before and After Sudden Death in the High School Setting

Purpose:

The purpose of our study is to examine the medical coverage, emergency action plans, policies, treatments, and predisposing factors of sudden death cases in the secondary school setting between January of 2000 and July of 2013. The proposed medical diagnosis for each sudden death during this time period has been obtained by the National Center for Catastrophic Sports Injury Research (NCCSIR), however the underlying predisposing factors from an organizational and administrative viewpoint is unclear. Based on current suggested best practices, development and implementation of appropriate policies and procedures, medical coverage, emergency action plans, and coaching education requirements are suggested to prevent sudden death in sport. We aim to explore the policies and procedures in place prior to and following each case of documented sudden death in the high school setting. Our research will hope to provide us with an in-depth analysis and allowing us to understand how to efficiently prevent the reoccurrence.

Methodology:

This qualitative study will utilize 3 Phases for the data acquisition, Phase 1: brief phone survey, Phase 2: online survey using Qualtrics™, and an optional Phase 3: in-depth phone interview. Data collection will commence January of 2015. Following the acquisition of schools that experienced a sudden death from the NCCSIR database, phone calls will be placed to each school to identify a school official (athletic director or principal) who has knowledge of the situation. The purpose of the study will be explained and verbal consent will be obtained. Participants will answer a few initial questions over the phone regarding the incident and will be asked to complete an online survey. The link to the anonymous online survey will be sent to participants where they have the flexibility to complete the interview at their leisure. The last question of the survey will give the participant the option to participate in an in-depth phone interview. This interview will identify the emergent themes surrounding their perception of the policies, treatment, and care of each sudden death case.

Aim:

The specific aim of our research is to, 1) determine the extent of the medical coverage provided in each case of sudden death and compare the types of medical services provided, 2) determine the percentage of schools that had Emergency Action Plans (EAPs) in place and the percentage that were correctly followed, 3) determine the percentage of schools that implemented policy and behavioral changes in response to the sudden death, and 4) gain the athletic directors perceptions on what might have prevented the death from occurring. The results will hopefully increase current knowledge surrounding medical care, policies, and preventative strategies both before and after sudden deaths in the high school setting.

Appendix F: Email Communication

E-mail Containing Phase II Survey (Initial):

To Whom It May Concern,

The link for the survey is with this email. Like we had discussed on the phone previously, your information is anonymous and will be linked to your Phase I section using your pseudonym that has been assigned to you. With your help, we aim to develop an understanding of the underlying factors that predispose an athlete to death in the secondary school setting. Please complete the survey under your own convenience, it is estimated to take 10-15 minutes. Thank you for your participation.

Research Team

Follow this link to the Survey:

[\\${1://SurveyLink?d=Take the Survey}](#)

Or copy and paste the URL below into your internet browser:

[\\${1://SurveyURL}](#)

Follow the link to opt out of future emails: [\\${1://OptOutLink?d=Click here to unsubscribe}](#)

2-Week Reminder E-mail Containing Phase II Survey

To Whom It May Concern,

THIS IS YOUR FIRST REMINDER E-MAIL

The link for the survey is with this email. Like we had discussed on the phone previously, your information is anonymous and will be linked to your Phase I section using your pseudonym that has been assigned to you. With your help, we aim to develop an understanding of the underlying factors that predispose an athlete to death in the secondary school setting. Please complete the survey under your own convenience, it is estimated to take 10-15 minutes. Thank you for your participation.

Research Team

Follow this link to the Survey:

[\\${1://SurveyLink?d=Take the Survey}](#)

Or copy and paste the URL below into your internet browser:

[\\${1://SurveyURL}](#)

Follow the link to opt out of future emails: [\\${1://OptOutLink?d=Click here to unsubscribe}](#)

4-Week Reminder E-mail Containing Phase II Survey

To Whom It May Concern,

THIS IS YOUR FINAL REMINDER E-MAIL

The link for the survey is with this email. Like we had discussed on the phone previously, your information is anonymous and will be linked to your Phase I section using your pseudonym that has been assigned to you. With your help, we aim to develop an understanding of the underlying factors that predispose an athlete to death in the secondary school setting. Please complete the survey under your own convenience, it is estimated to take 10-15 minutes. Thank you for your participation.

Research Team

Follow this link to the Survey:

[\\${l://SurveyLink?d=Take the Survey}](#)

Or copy and paste the URL below into your internet browser:

[\\${l://SurveyURL}](#)

Follow the link to opt out of future emails: [\\${l://OptOutLink?d=Click here to unsubscribe}](#)

Phase III Arrangement Email:

To Whom It May Concern:

Thank you for completing Phase I and II of our survey, at this time I would like to set up the final section, Phase III. This can be done at any time of the day; and it is done off of your convenience. Please respond with available dates and times that would work best for you. Multiple dates are recommended to ensure one of them will be available. Thank you and talk to you soon.

Research Team

Appendix G: Phase I Communication Via E-mail

Their Name,

Hello (Their Name), my name is (Your Name), a researcher at the Korey Stringer Institute at the University of Connecticut. I am one of the investigators for our research project that is examining secondary schools that have experienced a sudden death during sport or physical activity within the past 13 years, your school having one in (Year).

Here at the Korey Stringer Institute we serve as experts in the prevention of sudden death in sport and with this project we aim to develop an understanding of the underlying factors that predispose an athlete to death in the secondary school setting. Our project is a 3-phase study, with all being optional and may be discontinued at any point in time or after any phase. Your participation in this will be completely anonymous and at no time will the information be used for any other purpose. If you have knowledge regarding the situation and would like to start with Phase I, please feel free to give me a call on my phone (Phone Number), or e-mail me back here. Thank you for your time and I hope to speak with you soon.